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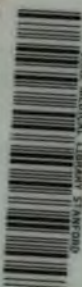
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who gives an account of eight cases which came under his own observation. These eight, together with two others, also referred to by Rokitsansky viz. the one described by Laennec, and one by Dr. Stenoch), the two described by Guthrie, two by Mr. Smith, one by Nivet, and two by Toddard and Pennock, being seventeen in all, were, until lately, so far as I know, the only recorded examples of this kind of aneurism. In almost all these examples the heart was diseased, and more especially in others dilatation with attenuation; and in many of them there were evident signs of stentomatous and calcareous deposits. According to Rokitsansky, it sometimes commences by disease of the middle and internal coats, in which case the continuity of these coats is destroyed, and the separation of the external coat follows as a later effect; in other instances, it is the consequence of chronic inflammation of the external coat, which gives rise to separation of that coat, followed by rupture of the middle and internal coats. In the one set of cases he considers that the rupture precedes, in the other, that it follows, the separation.

6th. The late Mr. Shakelton described a kind of aneurism previously unnoticed, in which the blood had forced its way through the internal and middle coats, dissected the middle from the external coat to the extent of four inches, and then burst again into the channel of the artery, thus forming a new channel, which eventually superseded the old one, — the latter having been obliterated by the pressure of the tumour. In this case the aneurismal sac was formed by five coats on the one side, and the external coat on the other.

7th. In the body of a man about fifty years of age, who had not been supposed to be the subject of any disease, and who died very suddenly before any medical man had an opportunity of seeing him, met with a singular variety of dissecting aneurism. In the neck of the aorta, about three-fourths of an inch to the left side of the origin of the left subclavian artery, there was a rent of the inner and middle coats, from this rent to near the origin of the aorta on the cardiac side, and for upwards of an inch on the aortic side the external coat was separated from the middle, round nearly two thirds of the circumference of the artery. There was an opening upwards of half an inch in diameter by which the aneurism thus formed burst into the pulmonary artery, a little below the place where that vessel gives off its two branches, the aorta was affected with stentomatous deposit in many places, and in the case there were, beyond all doubt, patches of the same kind of degeneration in the pulmonary artery. There was very slight hypertrophy of the left side of the heart.

A true aneurism is invariably limited at first; that is, it is not within a proper cyst; but, by rupture or ulceration, the cyst may way, and the blood become diffused through the surrounding tissue, in which case the aneurism is said to be diffuse.

IV. Contents of the Sac. The contents of an aneurismal sac are the same at all periods; they vary considerably, according to the duration of time that has elapsed since the commencement of the disease, but the sac contains only fluid blood, and in this state

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THE
PRINCIPLES AND PRACTICE
OF
SURGERY.

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BY

WILLIAM PIRRIE, F.R.S.E.,
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TO
THE STUDENTS OF SURGERY
OF
THE MARISCHAL COLLEGE AND UNIVERSITY OF ABERDEEN,
IN GRATEFUL REMEMBRANCE OF
THE PLEASURE HE HAS UNIFORMLY EXPERIENCED
IN HIS CONNEXION WITH THEM,
AND IN TESTIMONY OF
THE LIVELY INTEREST HE FEELS IN THEIR
PROFESSIONAL PROGRESS,
THIS WORK IS DEDICATED BY
THE AUTHOR.

PREFACE TO THE ENGLISH EDITION.

THIS work is not put before the public with the design of placing it in competition with any of the valuable treatises on the same subject already existing, but in compliance with a wish repeatedly expressed, on the part of the Students of Surgery at this University, to be furnished with a Compendium of my Lectures.

For their use the work has been prepared; and while I would venture to hope that others may find it not unserviceable, yet, if those, for whose especial use it is intended, derive benefit, my chief object will be obtained.

It has been my endeavour to combine simplicity of arrangement, and conciseness and clearness of description, with the elucidation of sound principles and practice. How far that endeavour has been successful, I must leave my readers to determine.

The wood-engravings are taken from drawings, the greater proportion of which are original delineations of preparations in my own Museum; others are of patients who were under my care while the work was in progress; and the rest are from authorities which are duly acknowledged.

To Dr. Westmacott of London, I am indebted for his drawing, from sketches furnished by Mr. Cleland of this place, the greater part of the original illustrations, as well as for directing the artist in the process of engraving. The remainder of these will fully sustain the reputation of

Mr. Bagg. To Dr. Bennett I owe acknowledgments for the use of many wood-cuts, illustrative of the inflammatory process, and of the microscopic character of Tumours. My warmest thanks are due to my Publisher, for permission to use the blocks belonging to Mr. Liston's "Practical Surgery," with beautiful and instructive engravings from which many pages of this work are adorned.

288 UNION STREET, WEST ABERDEEN,

February 7th, 1852.

EDITOR'S PREFACE.

THE duty which has been assigned the Editor, of bringing another Surgical work before the profession has been cheerfully undertaken, from his conviction of the high character and utility of the present volume. It is true, that comprehensive cyclopædias and manuals, and instructive treatises on special surgical subjects, as well as beautiful illustrations of surgical anatomy and operative surgery, have been issued from the press in great profusion; but the want of a suitable *text-book* on surgery has been constantly felt by those who are called upon to recommend to students a guide to their surgical studies, and who desire to place in the hands of their pupils the elements of sound principles, combined with safe practice.

This desideratum has been admirably supplied by Professor Pirrie, who has introduced recent views of pathology, and whose experience, both as a teacher and practitioner, has enabled him to give force and weight to his practical deductions; and we therefore venture to say, that no work has been offered to the medical public, which has so many claims to recommend it to the student of medicine.

Difficult as it is to limit the amount of matter that should be included in a work of this kind, at the same time, it is equally important that it does not encroach upon the province of a dictionary, or of a work upon Minor Surgery. If every topic had been introduced, it would have exceeded its

appropriate limits, and not fulfilled the precise object of its publication. The Editor has, therefore, added but few new articles, some of which are upon subjects that may render it more acceptable to the American Student, while the liberality of the publishers has enabled him to increase the number of the illustrations.

317 SPRUCE STREET,
July, 1852.

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THE

PRINCIPLES AND PRACTICE OF SURGERY.

CHAPTER I.

INFLAMMATION.

Definition.—Inflammation may be defined,—“a peculiar perversion of nutrition or of secretion,” attended with various abnormal conditions of the blood and its vessels, the most essential of which is exudation in the affected part.

To give greater clearness to the description of the phenomena of inflammation, we shall, in the first instance, allude to those produced by one of its most common forms.

Symptoms.—The symptoms of inflammation are divided into *the local*, comprehending the unusual appearances presented by the inflamed part, and *the constitutional*, affecting the general system.

Local Symptoms.—The principal local symptoms are the six following: redness, swelling, heat, pain, abnormal exudation, and impairment of function.

I. REDNESS.

Cause.—This symptom arises from an increased quantity of blood in the inflamed part, not only in the larger vessels, but also in the capillaries. The smallest of the capillaries, in their natural condition, are invisible to the unassisted eye, and allow only one blood globule to pass through at a time; but in inflammation they become so enlarged as to allow several to pass abreast. In some inflammations the redness is partly caused by extravasation of blood, but in most instances it depends on enlargement of the capillaries, and the consequent increase in the quantity of blood contained by them.

Varieties as to tint, extent, and form.—The tint of the redness varies in different inflammations; in common acute and sthenic inflammation it is bright and vivid, and the colour of arterial blood; in chronic and asthenic inflammation it is more of a dark or purple hue; in erythema it is a bright rosy red, and perfectly continuous; in erysipelas it is of a darker red; in erysipelas attended with great bilious derangement, it is of a yellowish red; in syphilitic inflammations it has something of a copper tinge; in scrofulous inflammation it presents a peculiar soft

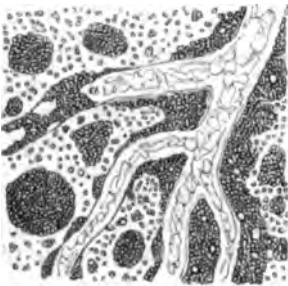
appearance; and when the inflammation is about to result in gangrene, it is of a dark purple or blackish hue.

The *extent* and *form* of the redness vary according to the character and intensity of the inflammation, and the nature of the tissue principally involved. In phlegmon, for example, it is circumscribed, in erysipelas diffused; in phlegmon it is gradually and insensibly lost in the surrounding parts; whereas, in the erratic form of erythema, it presents a distinctly defined margin, or may be said to be abruptly circumscribed. With regard to *form*, it may be linear, as in inflammation of veins and lymphatics; or punctiform, as in inflammation of the villi of a mucous membrane, which is not itself involved; or ramiform, as when the smaller arteries and veins only are seen distended; or capilliform, as when the distension of some of the capillaries is also seen; or uniform, as in erysipelas, when there is one continuous blush of efflorescence.

The presence or absence of redness is not, by itself, a proof of the presence or absence of inflammation.—Redness alone does not constitute inflammation; for it often exists without inflammation, as in the crimson spot of the hectic cheek, or in the blush of shame, or when produced by friction, or by the application of heat, or by the cupping glasses. On the other hand, the absence of redness is no proof that inflammation does not exist; for some inflammations, as those of the cornea and of the arachnoid membrane, are attended with opacity instead of redness. It is only in conjunction with other local indications that redness is regarded as a symptom of inflammation. The diagnostic peculiarity of inflammatory redness is its continuance so long as the inflammatory action, which causes it, still remains.

II. SWELLING.

Cause.—The swelling may, in the early stage of the inflammation, be occasioned in some slight degree by the increased quantity of blood; but it is chiefly caused by the effusion into the intervascular spaces of some matters called *products* of inflammation. The nature of these matters will afterwards be considered.



The *extent* of the swelling depends partly on the kind and violence of the inflammation, the more violent the action, the greater generally being the inflammatory effusion, and partly on the nature of the part affected, being greater in loose and relaxed textures of a supple and dilatable character, such as cellular tissue, than in those of a hard unyielding nature, such as bones. In loose textures, generally, the swelling is most remarkable.

Fig. 1. Granules and granular masses, filling up the intervascular spaces and coating the vessel at *a*. The transparent nuclei of cells may be seen here and there among the granules. Examples of intervascular deposit. Plenty of this will account satisfactorily for swelling.—*Bennett*.

The *consequences* of swelling vary much according to the importance, the delicate nature, the situations and relations of the part affected. In textures superficially situated, which do not perform a function of great importance, which are loose and dilatable, and so placed that the swelling cannot prevent the performance of any function essential to the animal economy, the occurrence of swelling is followed by relief, and is, therefore, favourably regarded by the surgeon; whereas, in some internal organs, in the sub-mucous cellular tissue of the glottis, and in many textures of a delicate nature, a very slight degree of effusion is sufficient to lead to a fatal result, and in some firm and unyielding structures it not unfrequently causes the total destruction of the part inflamed. The intelligent practitioner, therefore, in forming a correct judgment of the consequences likely to result from the effusion of products of inflammation, will be guided by a consideration of the site, relations, nature, and importance of the affected part.

Of swelling, as a symptom of inflammation, it may be remarked, that, like redness, it is generally greatest at the centre of the inflammation,—that it is, in most cases, gradually lost in the surrounding parts,—and that alone (as may be proved by many examples), it is no certain evidence of inflammation.

III. PAIN.

Pain varies in kind.—There are great varieties in the kinds of pain, depending on the part principally affected. It may be of a burning, tingling, or pruriginous character, as in certain inflammations of the skin,—or throbbing, as when the cellular tissue is affected,—or extremely acute, sharp, and lancinating, and greatly increased by stretching the inflamed part, as in inflammation of serous membranes;—sometimes it is dull, heavy, obtuse, of an exceedingly oppressive character, and attended with a feeling of nausea, as in inflammations of some glandular organs;—and sometimes it is of a severe, bursting character, as in inflammations of ligaments, fasciæ, periosteum, or bone.

Pain varies in degree.—Pain, in different kinds of inflammation, varies much in degree, being, in some kinds, exceedingly intense, so as to constitute by far the most urgent symptom, while in others it is comparatively slight. In some inflammations, under certain circumstances, there is no pain. Usually the intensity of the pain is in the direct ratio of the firmness and unyielding nature of the part affected. For example, ligament, bone, and fasciæ, structures which, when sound, are endowed with little sensibility, are extremely painful when they become the subjects of inflammation. There is generally more pain in external inflammations, and in inflammations of the investing membranes, than in those which affect the substance of the viscera, or mucous membranes. In inflammation of some parts of mucous membranes, there is only a sense of heat and uneasiness not amounting to actual pain. The pain is generally greater in common, than in specific inflammations, with the exception of gout. Of inflammation unattended with pain, the following examples may be enumerated:—insidious and indolent forms of scrofulous inflammations, in which extensive disorganization is often produced without the patient having ever been conscious of actual pain;—inflam-

mation in a part the subject of paralysis, or succeeding the division of the sensitive nerve of the eye, or in cases where the sensibility of the patient has been benumbed by the habitual use of intoxicating liquors;—very dangerous inflammations of the lungs in low kinds of typhoid fever, and those inflammations which affect the mucous membrane of the urinary passages, in complete anæsthesia of the lower parts of the body. The absence of pain, therefore, is no certain evidence that inflammation does not exist; and it is equally true that its presence is no sure proof of the existence of inflammation;—of this we have examples in cases of neuralgia. There is usually no difficulty in distinguishing between inflammatory and neuralgic pains; the former are invariably aggravated by pressure, whereas the latter are not only not increased, but often relieved by it. Neuralgic pain is generally intense from the commencement, and sometimes subsides suddenly; inflammatory pain steadily increases while the inflammation advances, having been at first, perhaps, nothing more than a slight increase of the natural sensibility. The sudden subsidence of pain in violent inflammations is more to be dreaded than desired, as it gives good reason to suspect that the part has lost its vitality, from the inflammation having gone on to gangrene.

The *site* of the pain is generally the site of the inflammatory action, but is in some instances at a distance from it; for example, in inflammation of the bladder or kidney, the pain is felt at the point of the urethra; in inflammation of the hip joint, it is felt principally at the knee; in inflammation of the diaphragm, or upper part of the liver, the pain is at the right shoulder; in some inflammations of the brain, it is felt more along the spine; and in inflammation of the spinal cord, it is sometimes felt along the thorax, and in parts of the limbs, more than at the seat of the disease. In all such cases the pain is termed sympathetic, and is met with principally in those instances in which the inflamed and painful parts are closely connected together by function; or where the latter contain the terminal expansions of nerves whose trunk or branches pass through or near the former. To avoid errors in diagnosis, these peculiarities as to the site of the pain should be carefully kept in view.

Cause of Pain.—The pain has been by some ascribed to compression of the nerves of the inflamed part by distended vessels and effusion; by others to an exaltation of nervous function, or to a painful stretching of the nerves arising from the distension of their small nutritious vessels; and by others to an impression produced on the *nervi vasorum* by the slight dilatation and elongation of the arteries during each impulse of the blood. From the facts that the pain is great where the nerves are most liable to be compressed, and that it is always increased by pressure (unless the pressure be steady, uniform, and such as to support the whole of the inflamed part), and from other considerations, it seems highly probable that pressure is the chief cause of the pain.

IV. HEAT.

Preternatural heat is usually characteristic of inflammation, and it was no doubt the general presence of this symptom, and an erroneous idea of the changes which take place in inflammation, that led to the adoption of the term derived from *inflammo*, to burn. This symptom,

like redness, varies much in degree, according to the violence of the inflammatory action, and the situation of the affected textures: in acute phlegmon, erysipelas, and certain inflammations of the skin and mucous membranes, it is considerable, and much complained of; while in some inflammations it is so slight as to be scarcely felt at all, or appreciated by the patient.

John Hunter made many experiments and observations to ascertain the actual increase of temperature caused by inflammation. He excited inflammation in the vagina and rectum of an ass, and in the cavity of the thorax of a dog; and in none of these instances did he ever observe the temperature to rise more than one degree above the natural heat of the part. He had occasion to operate on a man in St. George's Hospital for the cure of hydrocele, and on drawing off the fluid he found that the thermometer, on being introduced into the cavity of the tunica vaginalis, stood at 92° ; the next day, when inflammation had taken place, it stood at $98\frac{1}{2}$, being an actual rise of $6\frac{1}{2}$ degrees. He observed that on applying a blister to the chest, the difference of heat in the inflamed and surrounding parts did not exceed one degree or two; whereas on applying a blister to the extremities, which are naturally colder, the difference between the healthy and inflamed parts was found to be from five to six degrees.

These experiments and observations warranted the following conclusions:—That the increase of heat is not so great as the patient might by his feelings be led to imagine, nor as a bystander might suppose before making the experiment; that the greatest rise of temperature is found where the inflamed part is considerably removed from the centre of the circulation, and where the natural temperature is several degrees below that of the blood at the heart; that the actual rise of temperature in deep-seated parts is not more than one degree, but that in parts remote from the centre of circulation it may be several degrees; and that in every instance the heat is below the temperature of the blood at the heart. It is in the parts remote from the centre of circulation that the heat is most complained of.

The thermometer, however, only measures the degree of actual heat, whereas what the patient experiences is the sensation of it; and when we consider that not only is the sensibility of the inflamed part increased, but that the functions of the nerves also are increased and perverted, we need not be surprised that it is sometimes a very distressing symptom. An excellent writer on surgery has very happily remarked, "The heat of inflammation is partly actual, as ascertained by the thermometer, partly the result of perverted nervous function, estimated only by the patient."

John Hunter attributed the augmented heat to the increased influx of arterial blood. In all cases, animal heat is believed to be derived from the mutual action between the oxygen and the carbon and hydrogen of the tissues; and we may therefore conclude with Liebig, that together with an increased influx of blood, there is an increased amount of this kind of combustion, or an unnaturally rapid oxidation of the inflamed tissues.

V. ABNORMAL EXUDATION.

In every instance of undoubted inflammatory action, an exudation of blood-plasma occurs, and according to the ideas now entertained, this symptom is essential to inflammation. On this subject, I cannot deny myself the pleasure of giving the following quotation from Dr. Bennett's admirable "Treatise on Inflammation."—"Pain, heat, redness, and swelling, have been made to play too important a part in our views concerning inflammation. They are only present when the lesion affects the external surface, and are by no means applicable when it attacks many internal organs. I have seen cases of encephalitis, where no pain or heat was manifested before death, and where no redness or swelling was to be afterwards discovered, although an undoubted inflammatory softening existed. Inflammation also may attack the lungs, liver, kidneys, &c., and yet one or more of these supposed cardinal symptoms be absent. Again, slight incisions as those with a razor, are generally supposed to heal by means of inflammation, and so they do; but where is the pain, heat, redness, or swelling! In short, the symptoms of phlegmon, which so frequently come under the notice of surgeons, have been by them too generally applied to all inflammations. An analysis of these symptoms also will show that, whilst some depend upon the previous congestion, others are attributable to the exudation that follows it. Thus the heat and redness are caused by the former, whilst the pain and swelling usually result from the latter. The presence of these symptoms, therefore, cannot be considered as essential to inflammation; whereas the state can never exist, however slight, or however severe, without exudation of blood-plasma. Other pathologists have felt the difficulties which attend the considering exudation as a result rather than as the essential phenomenon of inflammation. Thus Dr. Alison observes, 'In order to give the requisite precision to the general notion of inflammation, as a local change of the condition of any part of the body, it seems only necessary to include in it, besides the pain, swelling, heat, and redness, the tendency always observed, even when the changes in question are of short duration, to the effusion from the blood-vessels of some new products, speedily assuming in most instances the form, either of coagulable lymph, or of purulent matter.' If instead of *tendency* to we read *existence* of, effusion, the principle laid down is certainly correct."

VI. IMPAIRMENT OF FUNCTION.

Impairment or perversion of function is an almost invariable symptom, varying much in character according to the organ affected, and the degree and progress of the inflammation. In many cases the function is first increased, then perverted, and afterwards, entirely arrested. Of many examples of this symptom, I shall mention only the following. The brain, when inflamed, no longer continues to perform its office, as an organ of intellect, having its function at first perhaps exalted as in delirium, and afterwards entirely suspended on the supervention of coma; the stomach is incapable, in inflammation, of performing its office, as a digestive organ; the kidney ceases to be useful as a uro-

poietic viscus; the bladder becomes impatient of the least distension by urine, and the eye becomes intolerant of the slightest impression of light. The perceptions of taste and smell are lost in inflammations of the mouth and nostrils, so that the parts are incapable of performing their special functions, while at the same time, their common sensibility is often considerably increased, and inflammations of the ear, or of the muscles and vessels, the affected parts fail in the performance of their proper functions. In internal inflammations, derangement of function is frequently an important guide towards forming an accurate diagnosis.

Constitutional symptoms.—The constitutional symptoms may be conveniently arranged into two general divisions:—first, the symptoms of sympathetic inflammatory fever; and second, the inflammatory appearances of the blood.

I. SYMPATHETIC INFLAMMATORY FEVER.

Various names have been employed at different periods to designate this disturbance in the general system:—it has been called Sympathetic Inflammatory Fever, Constitutional Fever, Sympathetic Synocha, General Vascular Reaction, Constitutional Disturbance, Sympathetic Fever, Symptomatic Fever, &c.

The patient generally has a sense of coldness, rigors, lassitude, and feebleness, followed by heat and dryness of skin, and generally by increased strength, frequency, fulness, and hardness of pulse. This is not, however, invariably the condition of the pulse; for example, in inflammation of the stomach and intestines it is small and exceedingly feeble, there being an early and decided depression of the action of the heart occasioned, as is supposed, by the combination of nausea with pain; and in inflammation of the brain attended by coma, the pulse is comparatively soft and slow. The respiration becomes hurried, and there is often an uneasy sensation of oppression in the chest; the face is flushed, and the head generally hot; the patient is restless, does not sleep well, complains of much general discomfort, and of dull pains in the loins and limbs; he cannot command his attention, and both the will and the power to exert himself are diminished; he loses his appetite and is usually thirsty; the tongue becomes white, loaded, and dry; the mouth is parched; the various secretions are deranged and diminished; the bowels constipated, the urine scanty and high-coloured, the functions of digestion and nutrition interrupted; emaciation soon becomes great, and debility excessive; there is incapacity for any mental exertion, and, ultimately, the mind is apt to become confused.

Sympathetic inflammatory fever is especially marked by the absence of certain symptoms which distinguish the different forms of what is called idiopathic fever, and more particularly by the absence of petechiæ, of any special eruption on the skin, or the peculiarly overpowering *depressio febrilis*, muttering delirium, *subcultur tendinum*, and stupor; in short, by the absence of those peculiar signs of derangement of the nervous system to which we give the name of typhoid symptoms.

II. INFLAMMATORY APPEARANCES OF THE BLOOD.

When blood taken from a person labouring under inflammation is received into a spherical, or into a deep vessel, and allowed to remain at rest, the two parts into which it separates itself, namely, the clot, cruor, or crassamentum, and the serum, present the following peculiarities:—

The clot is firmer and denser than that of healthy blood; the upper surface, which is of less diameter than the lower, is covered over with a whitish layer formed of fibrin, constituting what is called the buffy coat, and this surface is sometimes hollowed out into a cuplike form, in which case the blood is said to be both buffed and cupped. Under these circumstances, the coagulum is usually oval, but truncated at both extremities, broader below than above, and often adherent to the bottom of the recipient vessel. The coagulable lymph of surgeons, which is observed on cut surfaces, is identical in appearance and chemical characters with the buffy coat, and they, no doubt are the same substance. The apparent ratio of the clot to the serum is variable, depending materially on the figure of the containing vessel. When the coagulating blood is contained in a spherical vessel, the particles of fibrin, being little removed from a common centre, are more powerfully attracted towards each other, yield a denser clot, and squeeze out more serum than when the coagulation takes place in a shallow, wide basin, when the particles are spread over a large surface. The clot, in the one case, is compact and small; in the other, being spongy and retaining much of the serum, it appears to be of a larger size, although the actual quantity of solid matter is the same in both. When the blood is *sizy*, *i. e.*, but slightly changed, the clot is, for the most part, cylindrical, and floats in the serum.

The coagulation of blood taken from a person labouring under inflammation takes place more slowly than that of healthy blood; and to this circumstance the formation of the buffy coat has been sometimes ascribed. It may, indeed, be assisted by the slowness of coagulation; but it has been proved by many observations to depend principally upon some vital change in the blood itself, in consequence of which there is an unusual disposition to a separation of the fibrin from the red particles, or, as it has been expressed, “to a sort of repulsion between them.” This is exemplified, as was first particularly pointed out by Schröder van der Kolk, in blood abstracted by venesection during inflammation, and placed so as to form a mere film, so thin as not to permit a stratum of the buffy coat to be over a stratum of red particles; when the fibrin and the red particles separate from each other laterally by horizontal movements. This separation is distinct and immediate, and gives rise to a spotted or mottled appearance, which, like the cupped and buffed appearance, is regarded as characteristic of inflammation. By means of the microscope the separation may be beautifully seen in a single drop of inflammatory blood—the red particles become aggregated together in the form of rolls, which present an areolar arrangement, and leave interspaces for the fibrin, “lymph-globules,” and serum.

Such are the chief appearances of inflammatory blood. With reference to the buffy coat it is to be remarked that its extent varies according

to the violence and duration of the inflammation, and according to the character of the texture involved, being much greater in inflammation of fibrous and serous textures than in that of the parenchyma of internal organs; and that it is present in certain states unconnected with inflammation, as in the state of pregnancy, in the blood of chlorotic females, and in that of persons affected with general plethora.

LOCAL CHANGES.

By the aid of a microscope the following phenomena may be readily seen in the transparent parts of animals, as in the web of a frog's foot, after the application of a stimulus capable of exciting inflammation, such as alcohol, or acetic acid.

Fig. 2.



I. The capillary vessels are narrowed and the flow of blood through them accelerated. This stage is of very short duration, more especially

Fig. 2. An exact copy of a portion of the web in the foot of a young frog, after a drop of strong alcohol had been placed upon it. The view exhibits a deep-seated artery and vein, somewhat out of focus; the intermediate or capillary plexus running over them, and pigment-cells of various sizes scattered over the whole. On the left of the figure, the circulation is still active and natural. About the middle it is more slow, the column of blood is oscillating, and the corpuscles crowded together. On the right, congestion, followed by exudation, has taken place, constituting inflammatory action in the part.

a. A deep-seated vein, partially out of focus. The current of blood is of a deeper colour, and not so rapid as that in the artery. It is running in the opposite direction. The lymph-space on each side, filled with slightly yellowish blood plasma, is very apparent, containing a number of colourless corpuscles, clinging to or slowly moving along the sides of the vessel.

b. A deep-seated artery, out of focus, the rapid current of blood allowing nothing to be perceived but a reddish-yellow broad streak, with lighter spaces at the sides.

Opposite c, laceration of a capillary vessel has produced an extravasation of blood, which resembles a brownish-red spot.

At d, congestion has occurred, and the blood-corpuscles are apparently merged into one semitransparent, reddish mass, entirely filling the vessels. The spaces of the web, between the capillaries, are rendered thicker and less transparent, partly by the action of the alcohol, partly by the exudation. This latter entirely fills up the spaces, or only coats the vessel.—*Bennett.*

when the stimulus is very powerful; in which case it may pass so quickly into the next as to escape observation.

II. The vessels become greatly distended, and the flow of blood is slower than usual.

Such beyond all doubt are the first and second abnormal changes produced by the application of the stimulus.

III. The blood flows irregularly: it oscillates, that is, it goes backwards and forwards, and often is absolutely stagnant for a time. In the neighbourhood of the parts thus affected the vessels are distended and the circulation through them is more rapid than is natural; and over all the affected surface new vessels become visible, the explanation of which is believed to be that the red particles are received in abundance into vessels which previously contained them in such small quantities as not to be perceptible.

IV. The vessels become greatly distended, and the circulation of blood ceases entirely.

V. Blood becomes effused into the surrounding textures by rupture of the vessels, and liquor sanguinis is exuded without rupture.

VI. Besides these changes in the size of the vessels and the movement of the blood, others are observed in the relation of the corpuscles of the blood to each other, and to the walls of the vessels.

In the transparent parts of animals in the natural state, the red corpuscles of the blood circulate in the centre of the blood-vessels: and on each side there is a space containing the liquor sanguinis, and the lymph-corpuscles. Two currents are thus circulating, one in the centre, consisting of the red corpuscles, the circulation of which is very rapid; and the other at the sides, consisting of the liquor sanguinis with the lymph-corpuscles, the circulation of which is comparatively very slow. In inflammation the following abnormal changes may be seen. The lymph-corpuscles proceed very slowly in the lymph-spaces, and some of them become

adherent at certain parts to the sides of the vessels. The central column of red particles, as the vessels distend, becomes enlarged; the corpuscles encroach on the lymph-spaces, and gradually come into contact at some parts with the walls of the vessels; they become adherent to each other, so that their individual forms are no longer perceptible, and ultimately the vessels giving way some blood becomes extravasated, and the liquor sanguinis exudes through the walls of the vessels. The exudation of liquor sanguinis constitutes the essential phenomenon of inflammation, or in other words, its characteristic or pathognomonic feature; while the other phenomena constitute the state

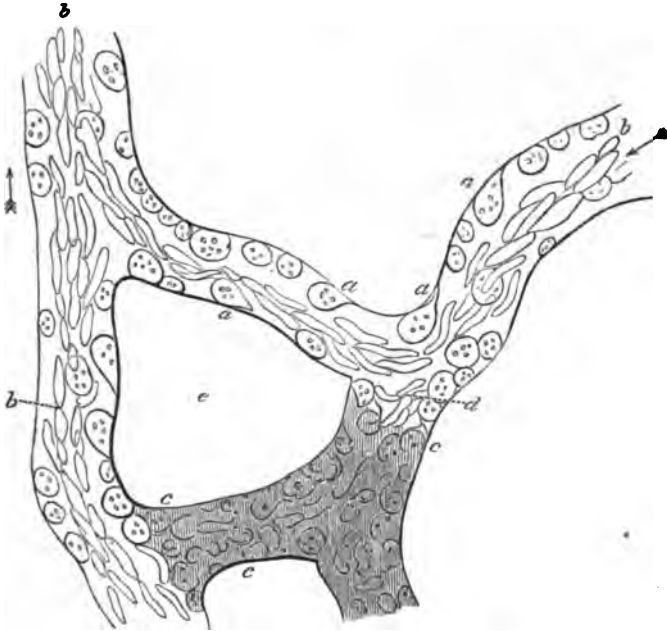
Fig. 8.



Fig. 8. Two vessels coated with granules, nuclei, and compound granular corpuscles. Example of Exudation.—Bennett.

of active congestion, which is one step short of inflammation. It is of importance not to confound congestion leading to inflammation with the

Fig. 4.



inflammation itself. Effusion of serum, capillary hemorrhage, or extravasation of blood may take place in consequence of other morbid conditions; but in the present state of our knowledge it is believed that inflammation never exists without the exudation of liquor sanguinis, and that this exudation alone is a proof of inflammation; it is, therefore, regarded as the essential phenomenon of that state.

TERMINATIONS, RESULTS, OR EVENTS OF INFLAMMATION.

Certain conditions resulting from inflammation were formerly called "terminations of inflammation." But to the use of this expression objections have very properly been made, on the ground that several of the conditions referred to are co-existent states with the inflammation, or successive stages in the progress of the same inflammatory disease, and the inflammation does not cease or terminate when these conditions occur. The words *results* or *events*, are not liable to the same objections, and are now used to denote these conditions. The results of inflammation which we have to consider are, *Resolution*, *Effu-*

Fig. 4. a. Colourless globules adherent. b. Blood-disks, still circulating. c. Dense, stagnant, homogeneous mass. d. Corpuscles in oscillatory movement, becoming detached from the impacted mass.—*Williams*.

sion of Serum, Exudation of coagulable Lymph, Suppuration, Ulceration, Gangrene, and Sphacelus.

I. RESOLUTION.

Resolution is said to occur when the symptoms gradually subside, and the liquor sanguinis becomes absorbed, so that no trace of it remains, and the part returns in all respects to its former condition and integrity. There is in short a subsidence or resolution of the inflammation, and this result, therefore, may be properly considered a termination of inflammation. The subsidence may be gradual, when the process is called *resolution*; or it may be sudden without symptoms of inflammation appearing in any other part, when it is called *delitescence*; or it may be sudden and abrupt, and the inflammation may suddenly appear in another part, and then *metastasis* is said to take place.

II. EFFUSION OF SERUM.

The liquid is deposited by exudation through the vascular coats yet entire, and consists principally of the serum of the blood slightly modified, being of higher specific gravity, and containing more albumen than in health, with more or less of fibrinous matter. This result is sometimes seen surrounding an inflamed part, in the centre of which there are other results of inflammation, and then the effusion into the areolar tissue surrounding the part in a higher grade of inflammation constitutes œdema, which is indicated by pitting on pressure. Diffusion of serum presents itself in inflammation of serous membranes, as for example, in pleuritis, when the quantity poured out is in some instances very great; and in such cases, if the effusion has taken place rapidly, it will be found on careful examination that the supernatant portion is usually clear, and the deeper portion turbid and more dense, owing to the fibrinous portions being of greater specific gravity, and sinking to the bottom. In this instance the blood-plasma which exudes separates into the serum and fibrin. The appearance, however, of the effusion varies according to the acuteness of the inflammatory process. The consequences of serous effusion vary much according to the part affected; in some situations it is comparatively harmless, while in others a trifling amount of effusion is sufficient to destroy life.

Serous effusion is often the result of congestion not inflammatory, and often of venous obstruction unconnected with inflammation. In every instance of undoubted inflammatory action, exudation of blood-plasma takes place, and the fluid, when poured into a cavity, is more or less turbid, and contains fibrin; whereas, when unconnected with inflammatory phenomena, the fluid is clear, and holds no fibrin in solution.

III. EXUDATION OF COAGULABLE LYMPH.

Of many examples which could be mentioned of this result of inflammation, two of the most frequent and striking are to be seen on the free surfaces of inflamed serous membranes, and on the edges of cut wounds. This has been called the adhesive stage of inflammation, and in wounds it leads to the union called by surgeons *union by the first intention*. In inflammation of serous membranes, the appearances presented by the

coagulable lymph vary according as the inflammation has been more or less acute, and in instances where it has been decidedly acute, according as it has been found more or less rapidly fatal.

The coagulable lymph, at the earliest period, and while it presents the gelatinous semitranslucent appearance, seems to consist of filaments made up of minute molecules arranged in lines. When the lymph becomes opaque, it appears to consist of the same filaments, larger in size, and consequently more distinct but less molecular, together with a quantity of corpuscles, which, on account of their constituting the characteristic structure of plastic lymph, have been denominated plastic corpuscles. When the lymph has become consistent, and the fluid part has been absorbed, cells, undergoing development into fibres, are observable. The filaments in recent lymph are believed to be results of deposition, and are therefore called *primary*; but those in old lymph are

Fig. 5.

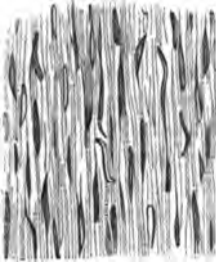
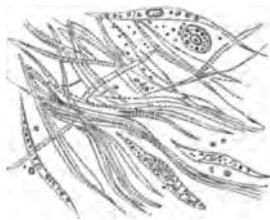


Fig. 6.



considered to be the result of cellular development, as originally described by Schwann, and are hence called *secondary*. In the case of cut wounds, exudation of plastic lymph takes place, and cells are developed which pass into fibrous formations; and the result is called *union by the first intention*. Different opinions have been advanced as to the mode in which new vessels are formed. Some think that the new vessels arise independently of the old, and are in a measure self-formed in the plasma, nucleated cells arranging themselves in lines and communicating by decadence of their opposing walls, and that the vessels thus formed afterwards connect themselves with the old vessels. Others are of opinion that blood-corpuscles escape from the original vessels adjacent, and hollow out for themselves channels in the plasma, and that these are, by and by, succeeded by others in a continuous stream.

IV. SUPPURATION.

This term is used to denote the transformation of the exuded matter into pus, a result most commonly found in cellular tissue, constituting an abscess, on the surface of granulating sores, and on the mucous membranes. Normal pus, such as that formed in phlegmonous abscess, or that yielded by healthy granulating sores, is an opaque, creamy, straw-coloured, or slightly greenish fluid, having a peculiar mawkish odour,

Fig. 5. Nuclei developing themselves into fibres.—Bennett.

Fig. 6. Cells developing themselves into fibres.—Bennett.

which it loses on cooling. On examination of its minute structure, it is found to consist essentially of two distinct parts; numerous minute organized particles, called pus-corpuscles, and a clear yellowish liquid, named the liquor puris, in which the corpuscles are suspended.

The form of the pus-corpuscles, in genuine pus, is perfectly spherical, with a finely granulated surface; they vary in size from 1-100th to 1-75th of a millimetre in diameter; in proportion as the pus deviates from the normal type, varieties are observed both in the form and size of the globules. When the corpuscles are examined in heaps, they exhibit a yellow tint; but when separately, they appear colourless. They are organized forms, and consist of a nucleus, cell-wall, and contents. The nucleus is for the most part composed of several granules, generally two or three, but sometimes four or five, and is hence called a composite *multiple* nucleus. It is not placed in the centre of the cell, and is usually attached to its inner surface.

On the addition of water, the pus-corpuscles become increased in size and more transparent, and they usually lose their finely granulated surface. Weak acetic acid partially, and strong acetic acid completely dissolves the cell-wall, and by that means the nucleus can be brought clearly into view.

The pus-corpuscles may be formed either from fluid cytoblastema, as in the fluid secretion of fresh wounds, in suppuration on the surface of the body after burns or blisters, and in suppurations on mucous membranes, as in catarrhs and gonorrhoea; or from a solid cytoblastema of fibrin after coagulation:—in other words, pus may be formed from fluid blood-plasma before coagulation, and also from exuded matter rendered solid. On the formation from fluid cytoblastema, Vogel remarks:—"The process of the formation of pus from a fluid cytoblastema can be best observed in fresh wounds cleansed from blood. In examining the fluid secretion from a wound, we first observe minute granules, less than the 1000th of a line in diameter, which are chemically identical with the molecules insoluble in the alkalis and in borax. There then appear, partly around these molecules and partly independent of them, somewhat larger corpuscles, soluble in the alkalis but not in acetic acid, identical with the nuclei of the pus-corpuscles. These nuclei appear sometimes isolated, sometimes in groups of twos or threes, thus forming corporate nuclei; around these the cell-wall is subsequently developed, first appearing as a pale transparent membrane, and subsequently becoming thickened and granular; and thus the pus-corpuscle is formed. The production of pus-corpuscles in this manner is tolerably rapid; in the course of three or four hours after the first appearance of the nuclei perfect corpuscles may frequently be seen: in other cases the process is slower." The formation of pus-corpuscles from a solid cytoblastema of coagulated fibrin

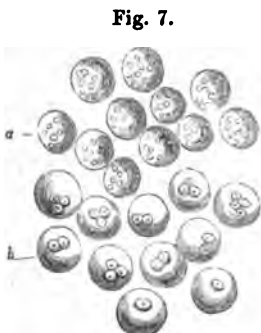


Fig. 7. a. Natural appearance of pus-corpuscles. b. Appearance after application of acetic acid.

is a process of frequent occurrence, as, for example, in abscesses in which the coagulated fibrin is changed into fluid pus, in cases in which pus is formed from the solid exudations from serous membranes, and in numerous other instances where a solid blastema is rendered fluid by the formation of pus. After the formation of the pus-corpuscles, the fibrin of the cytoblastema is exhausted, and the serum of the pus resembles greatly the serum of the blood. Pus-corpuscles are incapable of passing into permanent structures, or of undergoing a higher development, or of conversion into a more perfect organism.

When purulent matter is confined in the parenchyma of a part, in a cavity which is not natural, it constitutes an abscess; when infiltrated through the structures of an organ, the condition is termed purulent infiltration; when the purulent matter is formed on a mucous membrane, from which it is voided externally, the patient is said to have a purulent discharge; and when the matter forms an accumulation in some regular and natural cavity, the case is said to be one of purulent effusion, or of suppuration in that cavity.

Abscesses may be either acute or chronic.

ACUTE ABSCESS.

Symptoms.—When inflammation is about to lead to the formation of abscess, the symptoms which at first are the usual local and constitutional symptoms of inflammation, undergo a degree of aggravation. In many instances, however, the suppuration does not proceed so far as to produce sympathetic inflammatory fever. The pain becomes of a distressing pulsatory character, and often after the formation of matter it changes into an uneasy feeling of weight, or of heaviness and pressure; redness and tension, after being very great, are diminished, and the swelling, on being examined, presents different characters at different stages of the inflammation; being at first tense and hard in the middle, and oedematous around, and afterwards soft in the centre, hard at the circumference, and oedematous at a still greater distance from the centre of inflammation. When the swelling becomes raised up and prominent at one part, it constitutes the condition technically called the pointing of the abscess. In general, some time before the abscess points, fluctuation is discoverable, and this, taken in conjunction with the other symptoms, is one of the surest signs of the presence of matter, as it can only exist when there is fluid. At an early stage, however, when the superimposed structures are still thick and tense, and the quantity of matter but scanty, the perception of fluid is obscure, but it becomes more and more distinct, as the textures intervening between the abscess and the surface of the body become thinner. To discover whether fluctuation be present, the fingers may be pressed alternately on the swelling, or (which is preferable) the fingers of one hand may be applied to one side of the swelling, while, with the finger of the other, the opposite side is tapped, and the undulations of the pus will be distinctly perceived. Some surgeons greatly excel others in detecting the presence of matter. This skill is of great importance, and every surgeon should endeavour to acquire it in the greatest possible degree.

The *tactus eruditus*, as it is called, may be acquired by any one who

has experience, and acuteness of the sense of touch, together with the valuable talent of using them aright. When suppuration is deeply seated, so that fluctuation and pointing are not discernible, there are other symptoms (provided the inflammation be to a considerable extent), which afford pretty certain evidence of the formation of matter:—these are shiverings, technically called rigors, before the suppuration occurs, and after it has taken place, a change from the acute pain in the part to a feeling of weight, or numbness, or pressure, or some sensations totally different from those experienced during the acute inflammation. Antecedently to suppuration there is frequently interruption of the proper performance of the function of some organ, and if the abscess be deeply seated and large, the pulse ere long becomes feeble and increases in frequency; the patient becomes emaciated, and the constitutional symptoms are rapidly changed from those of inflammation to those of hectic fever.

The condition of the parts.—The condition of the parts in acute abscess may be stated to be:—suppuration, where fluctuation is perceptible; deposition of fibrin around the pus, offering a barrier to infiltration of pus into the surrounding textures, and constituting the hardness at the circumference; and, serous effusion into the parts external to the barrier of fibrin, giving rise to œdema, evidenced by pitting on pressure.

Treatment.—To remove general and local causes of excitement and irritation, and to promote the approach of the matter toward the surface, are important indications in the treatment of abscess. The best means of fulfilling these indications, are the strict observance of antiphlogistic regimen, perfect rest of the affected part, strict maintenance of a proper attitude, the removal of all sources of irritation, as well as of tension, or pressure, and the diligent use of warm emollient poultices, hot fomentations being applied each time the poultice is removed. Purulent matter having once been formed, it may be stated as a general rule in the treatment of acute abscess, that the grand indication then to be fulfilled is the early and free discharge of the matter. In some circumstances very early attention to this rule is of the utmost importance; as in abscesses under dense aponeuroses, and under thick fasciæ (as, for example, under the temporal aponeurosis, or under the tendon of the occipito-frontalis muscle, or under the fascia of the thigh, of the leg, of the arm, or of the fore-arm, or under the palmar or plantar fasciæ), within tendinous sheaths, as in paronychia tendinosa, or underneath the periosteum, as in paronychia periostei, or under the pericranium, in the proximity of bones, in the natural cavities, or in the texture of bones; also in abscesses arising from the extravasation of irritating fluids, as collections of matter caused by the extravasation of urine into the cellular tissue of the perineum and scrotum; abscesses in parts abounding with cellular tissue, when there is great risk of the spreading of the inflammation, or in situations where there is danger of making their way into some of the natural cavities, as into the chest, or abdomen, or the joints; or such as are likely to occasion injury by pressing upon or impeding the functions of important parts, as the trachea, the pharynx, the urethra; or abscesses, in highly vascular and sensitive parts, where

the pain of an abscess is often most excruciating. With scarcely more than one exception, early and free opening of an abscess is the proper course; but in the above-mentioned conditions, it is peculiarly necessary to adopt this proceeding at the earliest possible period after we are certain of the actual existence of matter: for not only are time and suffering saved and tissue preserved by its adoption, but by its neglect the danger of most destructive local results is increased, and in some circumstances, even the loss of life itself may result. Almost the only condition in which it is proper to delay opening, is in cases of glandular enlargement, in which, when other means have failed to produce absorption, and suppuration has occurred, the opening should be deferred, that the pressure of the matter may more effectually secure the disintegration and breaking up of the glandular structure, and thereby favour its removal.

Of the various methods of opening abscesses I shall refer to only two; namely, by means of a bistoury, and by means of caustic. The former is preferable, except in two conditions, presently to be mentioned. It consists in making a *free, direct* opening in a depending situation, and as already stated, at an early period. In the event of the matter making its way in a different direction, a second opening should be made, which, from often being opposite to the first, is called a counter-opening. By making an early, large, direct opening in a depending situation, and keeping it open while matter continues to be secreted, the formation of sinuses, loss of substances, and disintegration are generally prevented, and the desired result is attained more speedily, and with less suffering than it would be by any other proceeding.

The two conditions in which opening by means of caustic is preferable, are the following:—

1. In small abscesses, partaking of a chronic character, where the integuments are attenuated in consequence of the opening having been delayed, or where they are in a diseased state. In such cases the integuments are too much weakened to take on the necessary action for uniting with the subjacent parts; and as no healing process takes place until they are destroyed by ulceration, it is better to destroy them at once, and make a free opening by means of caustic. For this purpose the potassa fusa is preferred, and is applied so as to destroy the whole of the diseased and thinned integument.

2. In cases of glandular enlargement in the state of abscess, in which condition the caustic should be used very freely, and be pressed into the gland in different situations, so as to lead to the action by which the diseased structure may be separated and removed.

CHRONIC ABSCESSES.

Collections of matter sometimes form slowly and insidiously, and the symptoms of inflammation which precede them, are but slightly, if at all, perceptible; in such cases, the abscesses are said to be chronic. These collections often attain a great size; there being little fibrin effused around the matter, the sac is thin, and the resistance to extension feeble; they are frequently irregular in form, and the superimposed skin remains unaltered in colour.

The treatment of chronic abscess is a matter of great anxiety to the intelligent surgeon, in consequence of the danger, lest the opening of the sac should be followed by violent irritative fever, which has a tendency to merge very speedily into hectic fever. Where such collections are small, the patient's health tolerably good, and his constitution not very susceptible of inflammatory action, the treatment proper for acute abscesses, namely, free, direct incision, may be ventured upon; but as the danger of this proceeding is considerable, the surgeon is only justified in resorting to it in the conditions mentioned above. In all other cases, the treatment should consist in drawing off the matter by small valvular tapping—in closing up the wound so as to prevent the admission of air, by the presence of which, the opposite sides of the sac would be separated from each other, the putrefaction of the remaining matter promoted, and much constitutional disturbance induced,—in preserving the sides of the sac in contact, by gentle support,—and in renewing the valvular opening, before any great reaccumulation has taken place, so that the sac may not be allowed to regain anything like its former size, each opening being made with the observance of the same precautions as in the first instance. Sometimes, although very rarely, after the first operation the cavity contracts, and the desired result is obtained; but more frequently several repetitions of the operation are required, before the disease is cured; and in some instances, after the sac has become very much contracted by the adoption of the above procedure, it becomes safe to resort to the treatment for acute abscess, namely, free, direct incision, for perfecting the cure. The best apparatus for this mode of treatment consists of a long trocar, a canula furnished with a stop-cock, and a fine exhausting syringe which fits the canula. About an inch and a half or two inches from the spot where the sac is to be opened, a small aperture should be made in the skin; through this the trocar is to be inserted, carried under the skin, and sent through the sac where it is to be opened; the trocar should be withdrawn, the stop-cock being shut before it is completely removed; the syringe should be applied to the canula, and the matter drawn off, care being taken to shut the stop-cock after each stroke of the syringe. Gentle pressure should be applied to the sac, and while the canula is being withdrawn, pressure should be applied over its track, to prevent the admission of air; the opening should be closed up very carefully by means of plaster, and be preserved close, until adhesions have taken place. Rest, and every judicious precaution should be strictly enjoined, for some time after each operation, to diminish the danger of inflammation of the sac. This treatment is, in my opinion, the safest that has yet been proposed for this form of abscess, and by means of it, a favourable result is occasionally obtained; but in many instances, these abscesses are connected with incurable diseases of the bones or joints; and, as patients live much longer in such cases, when the abscesses are not opened, there can be no doubt whatever, that, under these circumstances, it is the duty of the surgeon to let them alone.

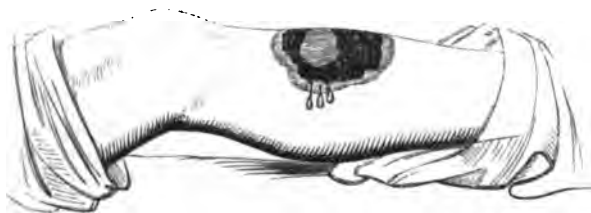
V. ULCERATION.

This is a frequent result of inflammation. Great differences are observed in the different tissues, with respect to their tendency to ulcera-

tion, when they become affected with inflammation, and these differences have important pathological bearing. It is most common in the skin, mucous membranes, cellular tissue, and the other tegumentary membranes; it is frequently met with in bones, and the inner coats of arteries, but is very rare in fibrous tissues of all kinds, in serous membranes, in the outer coats of arteries, and in nervous tissue. The process of ulceration, according to the views now entertained, is very clearly explained in the following quotation from Dr. Bennett's admirable "Treatise on Inflammation."—"The process of ulceration is somewhat similar to that of mortification, only it is more chronic, and the exudation, instead of undergoing decomposition, only exhibits an indisposition to pass into organization. In this case, the exudation is poured out slowly, it coagulates, and presses upon the surrounding parts, more or less obstructing the flow of blood to them, and acts as a foreign body. By means of the continued pressure, the circulation is obstructed, and death of the portion affected results. Sometimes this is imprisoned in fresh exudation, as ulceration extends, and the whole at length becomes disintegrated. All this time, the exudation exhibits little of that tendency so conspicuous in healthy persons, to undergo changes in itself, and when examined microscopically, is found to consist principally of very minute granules, varying in size from the $\frac{1}{128}$ to the $\frac{1}{32}$ of a millimeter in diameter. These are occasionally mixed with irregularly-formed cells, usually more or less angular, containing one or more granules. The cells are more numerous, in proportion to the stage of the ulceration, and the healthy powers of the constitution. These different granules and imperfect cells, with the structures they involve, at length become broken down, and separate from each other, constituting a semi-fluid mass, which has a tendency to point where it can most readily be discharged, that is, towards the surface of the skin or mucous membranes. Here, on account of the less degree of resistance offered, the continued pressure and disintegration of tissue first cause an aperture to be formed. Another portion of solid exudation is now broken down with the tissues involved in it, and in this way the opening is enlarged. If the morbid process continue, a fresh exudation is slowly poured out below the already coagulated blood-plasma, which supplies the loss thrown off in the form of discharge, and thus chronic ulceration may be increased indefinitely. The whole of this process may be well observed in scrofulous and syphilitic ulcers, or in the callosous sores of the leg in weavers, and others of a cachectic constitution. Indeed, the general powers of the constitution are almost always in such cases enfeebled, and hence the indisposition of the exudation to be transformed into organized cells. Ulcers produced by direct pressure are occasioned in a similar manner; only in most cases the pressure is not derived in the first instance from solid exudation poured out. Thus in stumps, not sufficiently covered by soft parts, in places long pressed upon by lying, or by the growth of tumours, the vitality of the part is slowly destroyed. At the same time an exudation is poured out from the neighbouring vessels, which becomes broken up, and assists in disintegrating the textures, whose vitality is destroyed. The finely molecular particles are thus absorbed, whilst the grosser portions are thrown off in the form of discharge."

Granulation.—The process by which the cavity is filled up, and continuity of tissue restored, is called granulation: it consists in exudation, from the surface of the cavity, of blood-plasma, constituting the fluid cytoblastema. Part of this blood-plasma degenerates into pus-corpuscles, but part becomes transformed into nucleated cells. Minute granules, forming the nucleoli (as they are called) are developed, and to the assemblage of these the term nucleus is given. On the nucleus, a cell-wall becomes developed, which, at first, closely embracing the nucleus, is afterwards raised up from it, and the nucleus thus separated from the cell-wall occupies an eccentric position within it. In these organized products vessels are formed, and the whole, when thus developed, constitutes a layer of granulations, spreading over the surface of the cavity, and giving it the appearance of being covered with innumerable small bodies of a conical form, and of a florid red colour. From the granulations blood-plasma is exuded, part of which degenerates into purulent matter for the defence of the granulations, and part is transformed into nucleated cells, by which a new layer of granulations is formed. The cells of the first-formed layer undergo further changes, and are ultimately developed into the texture of the part, from the vessels of which the exudation of blood-plasma took place, and each subsequent exudation furnishes a cytoblastema for the formation of purulent matter and nucleated cells. By the successive formation of these cells, by their becoming ultimately developed into permanent tissue, and by the centripetal contraction of the original textures, the cavity is filled up, and the next part of the process is *cicatrization*, or the formation of cicatrix. This usually begins when the granulations arrive on a level with the surrounding skin, when the blood-plasma, hitherto converted partly into pus-corpuscles, and partly into nucleated cells, passes into cells which, by the process of development, are converted into fibres, and constitute the cicatrix. The new skin usually takes its rise from the margins of the old skin; but in some few instances, portions of new skin are seen forming on the surface of the granulations, like little islands, quite remote from the margins. Some have endeavoured to account for this fact, but the supposition that the old skin has not been completely destroyed, as we not unfrequently find in burns, and that the isolated portions of new skin spring from the parts not entirely destroyed by the burn or ulceration; but I am convinced

Fig. 8.



by various cases which have come under my own observation, that this explanation is not satisfactory. I shall only refer to one case, that of a young lady, whom I had the opportunity of seeing, together with one of my colleagues in the University. The lady was the subject of pha-

gedænic ulcer, of considerable size and of great depth, in the leg; and as other means had had no effect in arresting the destructive action, the whole surface was destroyed to a considerable depth by pure nitric acid. After the removal of the slough, healthy action took place, and a large isolated portion of the skin formed in the middle, and gradually increased until it joined that formed from the circumference of the ulcer. I have for several years been in the habit of showing to my class in the University, a drawing of this case, as it is an incontrovertible instance of an exception to the ordinary rule of the formation of skin from the circumference only, and an evidence that the explanation mentioned above is not satisfactory.

ULCERS.

An ulcer may be defined—a solution of continuity caused by ulceration. Future chapters will give a description of specific ulcers, that is, ulcers caused by a specific poison, as syphilitic ulcers, and those connected with particular diatheses, such as the scrofulous, the scorbutic, or the cancerous. Other ulcers, not coming under either of these divisions, we shall, for the sake of clearness, arrange into seven varieties, namely:—1st, healthy ulcer; 2d, weak ulcer; 3d, indolent ulcer; 4th, inflamed ulcer; 5th, phagedænic ulcer; 6th, gangrenous or sloughing ulcer; and 7th, sloughing phagedæna.

In describing the appearances of ulcers, we shall refer to the state of the edges, the granulations, and the discharge.

I. HEALTHY ULCER.

The healthy ulcer, the simple, and the simple purulent, are different names given to the same ulcer.

Characters of a healthy ulcer.—The edges are smooth, neither inverted nor everted, and adhere to the granulations, and when the latter rise to a level with the common integument, a semi-transparent white film of cicatrix fringes round the edges, and gradually spreads over the granulations. The granulations are small, florid, firm, numerous, and pointed at the top, vascular, apt to bleed on being touched, sensitive, and attended with a slight feeling of tenderness instead of uneasiness or pain. When the granulations come to be on a level with the integument, they begin to be covered over by cicatrix. The discharge is thick and purulent, and easily separated from the surface of the sore.

Treatment.—The treatment consists in preserving the part at rest, maintaining such an attitude as will promote venous return, and prevent unpleasant sensations and consequences from tension, and in defending the part from the action of the air. Of the various means adopted for fulfilling this last-

Fig. 9.



mentioned indication, the most elegant is tepid water-dressing, applied by means of a small bit of lint with a piece of oiled silk over it to prevent the lint from being dried. The frequency of the dressing should depend on the quantity of the discharge; it being unnecessary to change it more frequently than is requisite to preserve the parts perfectly clean and comfortable. Another application still employed by some is simple ointment; but, for my own part, I almost invariably, like many others, give the preference to the tepid water-dressing, with a small piece of oiled silk, and a few turns of a bandage to afford gentle support when necessary.

II. WEAK ULCER.

Characters.—In the weak ulcer, called by many writers the fungous ulcer, the granulations, instead of being like those described in the characters of the healthy ulcer, are much larger, paler, flabby, less numerous, not pointed on the top, but, on the contrary, sometimes even bulbous, less vascular, less apt to bleed on being touched, less sensitive, unattended with pain, and when they have filled up the cavity of the ulcer, they rise up above the level of the surrounding integument, so that the margins are sometimes at this stage overlaid by them, and concealed from view. The edges are smooth, and the discharge is pale, and thinner than in healthy ulcer.

Fig. 10.



Treatment.—A necessary part of the proper treatment consists in removing, if possible, the cause; and, in addition to this, suitable means are to be adopted for removing the effects. The cause of the ulcer assuming the characters above described may be *general*, operating on the system at large, such as, a deficiency in the quantity or nutritive quality of food, an unwholesome atmosphere, a weak or disordered condition of the digestive apparatus, the debilitating effects of mental anxiety, or feebleness of constitution, however induced; or the cause may be *local*, such as improper treatment, as, for example, the use of relaxing applications, venous congestion caused by some obstacle to the

return of the blood, or a weakened condition of the parts occasioned by the nature of the injury of which the ulcer is the result, or the delay of cicatrization, for perfectly healthy granulations become weak when healing is by any cause delayed. With regard to local treatment, rest should be enjoined, and an attitude favourable to venous return; together with the careful application of gentle pressure by uniform bandaging, which acts as a gentle stimulant to the granulations, and corrects the tendency to passive congestion. The use of a medicated water-dressing of a stimulant nature, instead of plain tepid water-dressing, should also be adopted. Solutions of the sulphate of zinc, or the sulphate of copper, varying in strength from one to two grains, or even more, to an ounce of water, generally answer most satisfactorily in the treatment of this ulcer. I usually prefer the solution of the sulphate of zinc, either the simple solution, or medicated with two drachms of the compound spirit of lavender and a drachm of the spirit of rosemary to eight ounces of water. The lotion should be kept applied by means of a little lint, with a piece of oiled silk placed over it to prevent drying, and at the same time bandaging should be employed, not merely as in healthy ulcer for retentive purposes, but to secure gentle and uniform pressure.

Other modes of treatment which have been adopted are, pressure together with the application of dry lint to the granulations as a dressing, shaving off the fungous granulations with a knife, and destruction of them by escharotics. The treatment already described will very rarely be found to fail in producing the desired effect; but when it does fail, recourse may for a short time be had with advantage to pressure, with a dressing of dry lint.

III. INDOLENT ULCER.

Characters.—The form of this ulcer is seldom irregular, but usually nearly oval or circular. The edges are thick, prominent, comparatively insensible, glossy, smooth, firm, incompressible, and without any appearance of cicatrix; the surrounding parts are also firm, hard, incompressible, and usually discoloured by passive congestion; the surface of the ulcer is nearly devoid of granulations, is smooth and glossy, and varies in colour, being in some examples whitish, in some gray, and in others brownish. The discharge is scanty, thin, and watery. This ulcer may be said to be almost exclusively confined to the labouring poor, occurring in their lower extremities, and after the middle period of life.

Treatment.—An important indication, as may readily be imagined, in the treatment of this ulcer, is to improve and maintain the general health and strength; and with this view, generous diet, residence in an airy situation, and the due regulation of the digestive organs should be prescribed, together with the use of tonics in many instances, and even of stimulants, when indicated by the particular circumstances of the case. Of many different modes of treatment I shall refer only to two, namely, that suggested by Mr. Baynton, and that by Professor Syme. Of these the former has hitherto been generally regarded with favour, and has received the general adoption of the profession. When it is carefully conducted, its results are very satisfactory. The following is

Mr. Baynton's description of his method of treatment:—"The parts should be first cleared of the hair, sometimes found in considerable quantities upon the legs, by means of a razor, that none of the dis-

Fig. 11.



charges, by being retained, may become acrid and inflame the skin, and that the dressings may be removed with ease at each time of their renewal, which in some cases, when the discharges are profuse and the ulcers very irritable, may perhaps be necessary twice in twenty-four hours, but which I have in every instance been only under the necessity of performing once in that time. The plaster is to be cut into slips about two inches in breadth, and of a length that will, after being passed round the limb, leave an end of about four or five inches. The middle of the piece, so prepared, is to be applied to the sound part of the limb, opposite to the inferior part of the ulcer, so that the lower edge of the plaster may be placed about an inch below the lower part of the sore, and the ends drawn over the ulcer with as much gradual extension as the patient can well bear; other slips are to be secured in the same way, each above and in contact with another, until the whole surface of the sore and the limb is completely covered at least one inch below and two above the diseased part. The whole of the leg should then be equally defended with pieces of soft calico, three or four times doubled, and a bandage of the same, about three inches in breadth and four or five yards in length, or rather, as much as will be sufficient to support the limb from the toes to the knee, should be applied as smoothly as can possibly be performed by the surgeon, and with as much firmness as can be borne by the patient. It is to be first passed round the leg at the ankle-joint, then as many times round the foot as will cover and support every part of it except the toes, and afterwards up the limb till it reaches the knee; observing that each turn of the bandage should leave its lower edge so placed as to be about an inch above the lower edge of the fold below it." The success of this method of treatment, when applied in suitable circumstances, is generally acknowledged. Callous ulcers are often presented for treatment in an inflamed state; soothing applications should in such circumstances be prescribed, until that condition be removed, and the treatment above described may then with propriety be resorted to. One great advantage of this method of treatment is, that perfect rest and constant elevation of the limb are not so essential auxiliaries as in other methods; and this is, in some circumstances, a matter of great importance. The good effects of this mode of treatment are properly ascribed to pressure, which, by promoting absorption of the swelling, favours the contraction requisite for

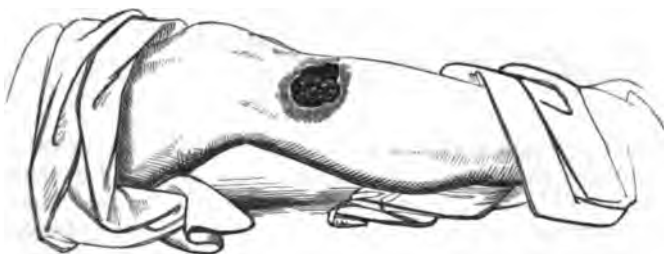
cicatrization. The merit of first pointing out the beneficial effects of pressure in the treatment of this ulcer is due to Mr. Whateley, who applied pressure by bandages alone; that of prescribing adhesive plaster, together with the use of a bandage, belongs to Mr. Baynton.

Professor Syme's treatment consists in the application of a blister sufficiently large to cover the ulcer, and a portion of the surrounding parts. In favour of this mode it is urged, that it is more speedy and more economical than Baynton's; but as the risk of erysipelas is considerable, and as the first effect is to enlarge the ulcer (which is far from desirable, although it may improve its character), it has always appeared to me, that as a general practice, the method of Baynton is to be preferred: at the same time, however, I am perfectly aware that satisfactory results are often obtained by the adoption of that of Syme.

IV. INFLAMED ULCER.

Characters.—The edges and surrounding parts are red, swollen, hot, tense, tender, and painful; the surface of the sore is destitute of granulations, and presents a raw and pulpy, or a foul and livid appearance; the discharge is profuse, offensive, and often streaked with blood, mingled with ulcerative debris. The pain is great, and there is always more or less constitutional disturbance.

Fig. 12.



Treatment.—The object aimed at in the first instance being the conversion of the inflamed, into a simple, healthy ulcer, undue irritability and excessive action must be first subdued; and for this purpose general, as well as local, treatment must be instituted. The diet should be carefully regulated, and the secretions of the digestive organs, and of the skin, be brought into a proper state by purging, antimonials, calomel, and opium, or such other remedies as seem to be indicated by the particular circumstances of the case. With regard to local treatment, perfect immunity from motion, the observance of an attitude calculated to promote venous return and relaxation, are absolutely indispensable; of local applications, the most useful are warm poultices and fomentations, or opiate poultices, and opiate fomentations; in short, heat with moisture, or heat and moisture combined with opiate applications, are the most soothing remedies. Simple poultices, or poultices medicated with decoction of opium, are very useful and grateful in such cases. Local depletion by leeches, or scarification of the edges of the ulcer, is sometimes resorted to, but it is very seldom indeed that such a proceeding is necessary.

V. VI. VII. PHAGEDÆNIC ULCER.—GANGRENOUS ULCER.—SLOUGHING PHAGEDÆNIC ULCER.

The characters and treatment of the phagedænic and the gangrenous ulcers, and of sloughing phagedæna will be minutely described in the chapter on the state of constitution in which they are most frequently

Fig. 13.



observed; but their characters may be briefly stated in this chapter. The three varieties—namely, phagedæna or phagedænic sore, sloughing or gangrenous sore, and sloughing phagedæna, called by some writers

Fig. 14.



the phagedæna gangrenosa, are so similar to each other in the circumstances in which they are found, in their symptoms and in their treatment, that it will be more convenient to describe them together than to assign a separate section to each. The term phagedæna, derived from φαγω, to eat, is well applied to this kind of ulcer, as there is the appearance of regular eating away, or destruction by phagedænic ulceration, without any attempt at granulation.

Phagedæna, or a phagedænic ulcer, may be distinguished by the following peculiarities. The edges are extremely irregular, and of a dark purplish appearance, a red colour extending a considerable way into the surrounding parts; they are exceedingly painful, and at parts inverted; the surface of the sore is uneven, and extends underneath the edges; it is of a livid or dark red colour, and, together with the edges, has a very irritable appearance. It is covered by a thin, ichorous, bloody discharge. The sore enlarges with alarming rapidity; and the destructive process may continue to be carried on, by ulceration alone, or by ulceration together with sloughing, so as to constitute the variety called by some writers the sloughing phagedæna, and by others the phagedæna gangrenosa. In the other variety, namely, the sloughing sore, the destruction is by sloughing alone; the sore enlarges by the formation of one slough after another, and the surface of the sore on the separation of the slough, has a raw, red, irritable appearance. These three varieties

exhibit the same appearance of edges, and occur in similar circumstances; they differ chiefly in the appearance of the surface of the sore; there being in the phagedænic sore an irregular appearance of the surface, occasioned by the ulcerative process; in the sloughing phagedæna the same appearance at some parts, and a wet ash-coloured slough at others; and in the sloughing variety a wet slough covering the sore. The characters of these ulcers are so peculiar that there can be no difficulty in distinguishing them from each other, or from any of the other varieties of ulcers. A high degree of constitutional disturbance attends each of these varieties. The constitutional symptoms and treatment will be given in a future chapter.

GANGRENE AND SPHACELUS.

The three terms—Mortification, Gangrene, and Sphacelus, have been indiscriminately used by some authors to express an important result of inflammation, namely, the death of the part. In the use of them here, we shall follow the guidance of those who regard *mortification* as a generic term comprehending the whole series of phenomena, from the first diminution of the vital powers to their entire destruction; *gangrene*, as denoting the stage in which there is diminution but not perfect destruction of the powers of life; and *sphacelus*, as denoting the complete death of the part.

Local and Constitutional Symptoms of Gangrene and Sphacelus from Inflammation.—In gangrene the redness is changed into a dark or livid hue; the heat, sensibility, and pain are diminished; the swelling, though not diminished, but sometimes even increased in extent, is less tense, and generally pits on pressure; and on different parts of the surface we usually find portions of the cuticle elevated into small blisters, called phlyctenæ, containing unhealthy serum of a yellowish or greenish colour. These symptoms do not indicate an entire extinction of the vital powers, and, consequently, the part sometimes recovers, or only a very small portion of it becomes dead. Generally, however, the symptoms of gangrene merge into those of sphacelus, in which the part presents a black, a dark, or an ash-gray colour, according as it is more or less exposed to the atmosphere; it becomes cold, and not only ceases to be painful, but entirely loses its sensibility; instead of having the appearance of excessive distension, as in the inflammation preceding the occurrence of gangrene, it becomes soft, flaccid, and shrunk in its dimensions: it crepitates on pressure, and emits a peculiar cadaverous, characteristic odour. Such are the local appearances of the sphacelated part. This part is called the *slough*, and the process by which it is formed, *sloughing*. When the mortification has a disposition to spread, the dark colour extends, and is insensibly lost in the surrounding parts; whereas, when the mortification ceases to spread, a red line, called the line of demarcation, separates the sphacelated from the living parts. This line is, in the living part, in immediate contact with the dead, and its appearance is always regarded as most important, as indicating not only that sphacelation or sloughing has ceased, but also that a process has been commenced by nature for the removal of the sphacelated part

from the system. In this process, exudation and partial organization of fibrin precedes suppuration and ulceration, and thus hemorrhage from vessels, and infiltration into loose tissues, are both prevented. As the process advances, the cuticle is separated from the line of adhesive inflammation, and the part exhibits the appearance of a circular vesicle; this gives way, and an inflamed and ulcerated surface is then brought into view, called the line of separation. The continuity of the parts being thus fairly interrupted, the furrow deepens and extends, till the sphacelated portion is entirely detached, leaving, generally, a healthy granulated surface. In this very remarkable process, there are various results of inflammation, namely—adhesion, which effects two purposes, preventing both hemorrhage and purulent infiltration,—ulceration and suppuration; the ulceration being for the purpose of effecting the separation. The process is the same, whether it extends only to a certain depth below the surface, or whether the whole thickness of the part perishes. In the latter case, remarkable as this process is, the surgeon does not leave to nature the work of amputation, partly on account of the length of time that would be required, and partly because of the irregularity and form of the stump that would be left, as the ulceration, in these circumstances, does not proceed perpendicularly to the surface, but in a slanting direction, leaving the bones uncovered. To obtain, therefore, a more useful stump, the surgeon resorts to amputation. The question of amputation, and the time and site that ought to be selected when it is advisable, will be considered in a subsequent chapter.

Local changes in inflammatory Mortification.—Dr. Bennett, to whom the profession is much indebted for his valuable “Treatise on Inflammation,” gives the following description of the condition of the parts in inflammatory mortification. “Occasionally a very large amount of blood-plasma is thrown out, constituting a violent inflammation; a greater or less number of capillaries are also ruptured, and blood-corpuscles are more or less mixed up with the *liquor sanguineus* exuded. The exudation thus formed compresses the part, so as to obstruct the blood-vessels, and prevent the continuation of any circulation in it. Under these circumstances, instead of forming a blastema for the production of new organisms, it undergoes chemical changes, which induce in it decomposition, and the part is said to be mortified, or to be affected with moist gangrene. This change commences first in the blood extravasated, which becomes of a purple colour, more or less deep; corpuscles break down and become disintegrated; their hematosine dissolves, and colours the serum, and should the exudation have coagulated, it forms brown, rust-coloured, purple or blackish masses. An acrid matter is now formed, which, acting on the neighbouring tissues, produces fetid gases, that are abundantly given off from the affected part. Sulphuretted hydrogen is evolved, which causes the blackish sloughs usually observed in such cases, and discolours silver probes, and the preparations of lead. After a time, the elementary tissues surrounding or involved in the exudation, become more or less affected. The transverse striæ, in the fasciculi of voluntary muscles, become first pale, and are then obliterated. Cellular tissues, fat, and other soft substances, lose their connexion, and fall into an undefined granular mass. The tendons and fibrous tissues retain

their characteristic structure for a long time after the other soft parts have been reduced to a softened pulp. The bones resist the action longer, but at length become rough, soft, and commencing externally, are more or less broken down, and reduced to the same pulpy consistence, and granular structure, as the surrounding parts. As the tissues thus become broken down and fluid, they are discharged from the system in the form of an ichorous matter, which, examined microscopically, presents numerous granules, imperfect or broken-down cells, blood-corpuscles, and fragments of filamentous tissue or other structures involved."

Constitutional symptoms of inflammatory Mortification.—During the inflammation which precedes the mortification, and when a disposition to form a line of demarcation is observed, the constitutional symptoms are those of inflammatory fever; but when the mortified part is of great importance in the animal economy, or when the mortification is extensive, the constitutional symptoms very speedily merge into those of the worst typhoid type. Some of the principal symptoms are the following:—the pulse is rapid, thready, and feeble, in some instances irregular, and in others intermitting; but the most striking peculiarities of the pulse are great diminution of strength, and great increase of frequency, and before death it becomes exceedingly indistinct and flickering; the patient lies on his back; the countenance is cold and has an expression of great anxiety; the features are pinched, and the face has a peculiar livid hue; the tongue is at an early period furred and dry in the middle, and ultimately the whole of the mouth exhibits the same condition; hiccup comes on, and occasionally vomiting of a substance of a coffee-colour; the patient is often observed picking at the bedclothes; the skin is at first dry, but as the case advances it becomes cold and clammy; on pressing the hand to it, it feels raw, and is so relaxed, that on the hand being raised up, it gives the impression of sticking to the hand so as to follow it slightly and be raised up from the subjacent parts; the perspiration, like the other secretions, has a peculiar cadaverous odour; the evacuations are passed involuntarily; the patient sometimes retains his mental faculties to the last, but more frequently he is affected with low muttering delirium. Such are the symptoms that precede the closing scene in many examples of death from inflammatory mortification.

CHAPTER II.

ERYTHEMA AND ERYSIPELAS.

I. ERYTHEMA.

IN this chapter it is proposed to give a brief but comprehensive account of the doctrines of Erythema and Erysipelas. To render the description more clear, we shall refer to the different varieties of those affections, stating their symptoms and causes, together with the circumstances under which they are usually met with, and their treatment.

Erythema (from *ερύθημα*, redness) is a term to which all writers have not been careful to affix the same signification. Hippocrates used it to denote any kind of morbid redness of the skin; at a subsequent period Celsus, and still later, Galen substituted the term erysipelas for erythema, and this has, no doubt, occasioned part of the confusion which has arisen in the use of the term; some others, employing it as synonymous with idiopathic erysipelas, others to designate the slightest grade of erysipelas; while some, as J. P. Frank and J. Frank, have applied it to several affections of a chronic kind, perfectly distinct from those to which it has been given by recent British and French pathologists.

Erythema, in the sense in which the term is generally employed in this country, may be defined to be a superficial redness of the skin, disappearing momentarily on pressure; usually of an acute character, and not infectious; attended with a burning pain, tenderness, and dryness of the part, and generally unaccompanied with vesication, or with swelling beyond a slight and barely perceptible degree. On the subsidence of the inflammation the part is covered with scales, in consequence of desquamation of the cuticle.

The idiopathic, or primary, or local, form generally proceeds from some topical irritation, as friction, attrition of contiguous surfaces, pressure, irritation caused by morbid secretions, by vicissitudes of temperature, by chemical or mechanical irritants, or by stings of insects. Even this form of erythema, although caused by topical irritation, is favoured by, and almost always more or less associated with, disorder of the digestive, excreting, or eliminating organs. The increased action very rarely rises beyond the grade of active congestion; and the slight form of the local affection, its non-extension to the cellular tissue under the skin, and the very limited amount of constitutional disturbance, sufficiently distinguish erythema from erysipelas.

In this form the proper local treatment consists in the removal of the cause of irritation, rest, an attitude favourable to venous return,

and fomentations; and should these prove insufficient, in pencilling over the part with a strong solution of the nitrate of silver. Rest, restriction of diet, and a few gentle alterative aperients, constitute the general treatment; and for preventing the return of the disease, the most important precautions are, to avoid exciting causes of the affection, and to use proper means for regulating the functions of the stomach, the liver, and the skin.

The sympathetic erythema of Rayer may be said to comprehend the different varieties enumerated by Willan and Bateman; these are the six following:—*erythema fugax*, which appears upon the breast, arms, and face, in cases of bilious diarrhoea, in certain affections of the alimentary organs, and in various febrile disorders: *erythema leve*, which is most frequently met with as an accompaniment to anasarca or oedematous swellings, but occasionally attends the catamenia in weak and irritable females, and is sometimes symptomatic of disorder of the digestive system: *erythema marginatum*, which, deriving its name from being bounded on one side by a hard, elevated border, occurs chiefly in old persons in the progress of some internal disorders, and is always regarded as an unfavourable symptom: *erythema papulatum*, sometimes attended with general disturbance of a slight nature, but frequently with anorexia and much prostration of strength: *erythema tuberculatum*, a very rare variety attended with great languor, irritability, and restlessness, and succeeded by hectic (Bateman never met with this variety, and Willan only saw three examples): and *erythema nodosum*, which shows itself in vivid patches on the foreparts of the legs, mostly in young females of a relaxed constitution; is preceded by slight febrile symptoms, and is sometimes connected with the approach of the catamenia.

Rayer mentions another variety which other observers have overlooked—*general erythema*. A case came under my notice some time ago, which I believe was an example of this variety: the pulse was rapid and feeble, the redness was pretty general over the body, there was great prostration of strength, the tongue was dry, and the bowels very loose; it continued nearly a week, and was followed by desquamation.

The different varieties of symptomatic erythema must all be treated by internal or constitutional remedies, and according to indications furnished by the internal disorders which they are found to accompany.

II. ERYSIPELAS.

Names and Definition.—Erysipelas, derived from *ἐρῶ*, *I draw*, and *πῶς*, *adjoining*, so named from its tendency to spread to the adjoining parts of the skin, may be defined to be an inflammation of the skin and subjacent cellular tissue, characterized by a deep-red tint, by swelling of the parts affected, and by a remarkable tendency to spread by continuity. It is also called the Rose, from the colour of the integument, and St. Anthony's Fire, a name given to it in former ages on account of the burning heat which accompanies it, and from the belief that St. Anthony had special power to heal this kind of disease.

Divisions.—The varieties of erysipelas have been very differently

divided by different writers. Some have proposed a division according to the region in which the disease appears:—1st, Erysipelas of the face and head; 2d, Erysipelas of the trunk; and 3d, Erysipelas of the extremities. Burserius suggested a division according to the supposed causes:—1st, Primary, or Idiopathic, when it arises from an internal disease not preceded by any other; 2d, Symptomatic, or Secondary, when it supervenes on another disease; and 3d, Accidental, when excited by some obvious external cause. Biett and Cazenave divide them into True and Phlegmonoid; Alibert and Rayer into Simple, Phlegmonous, and Œdematous. The division employed by Willan and Bateman was into Phlegmonous, Œdematous, Gangrenous, and Erratic; and that by Desault into Phlegmonous, Bilious, and Local. We shall refer to the following varieties:—1st, Simple; 2d, Phlegmonous; 3d, Œdematous; 4th, Bilious; 5th, Erratic; and 6th, Periodic.

SIMPLE ERYSIPELAS.

Symptoms.—Simple, called by some authors true or legitimate erysipelas, is characterized by the following symptoms:—Redness of the skin, more or less vivid, occasionally partaking somewhat of a livid and in many instances of a yellow tint; disappearing under the pressure of the finger, but returning on its removal; and defined by a distinct elevated margin, which irregularly circumscribes it; slight tumefaction, never acuminate or convex; and pain of a tensile, peculiar, or stinging character, accompanied by itching, and a sense of burning diffused over the whole inflamed surface. For three or four days these symptoms continue to increase in intensity, and then begin to decrease, remaining, however, in some degree for three or four days longer. When the inflammation is acute, small miliary vesicles, like those of eczema, are developed on the inflamed skin, and when it is very intense bullæ or phlyctenæ often appear on the erysipelatous part. These bullæ may be isolated or confluent; they burst soon after their appearance, most frequently about the fifth or sixth day of the disease, and the humour they emit dries on the skin, forming flavescent crusts, which afterwards become brown or blackish, and ultimately are detached along with the epidermis, which falls off in scales.

The local symptoms usually make their appearance after certain precursory signs, such as languor, lassitude, depression, shiverings, general uneasiness, nausea, and very frequently other manifest symptoms of disturbance of the functions of the alimentary canal. The constitutional symptoms take the precedence for some time; then the local symptoms appear, and afterwards they increase and decrease together. It has, however, been correctly remarked by careful observers, that the local disorder is by no means invariably in the direct ratio of the severity of the febrile symptoms.

Results.—The most frequent and most favourable result of this form of erysipelas is resolution; slight discoloration and thickening of the skin, together with desquamation of the epidermis, remaining for a very short time, and then disappearing. In the very mildest form there is scarcely any desquamation, but in more acute cases it is considerable, and slight thickening of the skin and discoloration remain for a short

time; and if the action be still more intense, serous effusion may take place, both on the external surface of the cutis, constituting bullæ or phlyctenæ, and in the subcutaneous cellular tissue, which becomes infiltrated. By the absorption of the fluid in the cellular tissue, and the bursting and desiccation of the vesicles on the surface, all traces of the disease disappear. At a certain stage, in some cases, the part is found to be covered over with dry cuticle, and, in others, where bullæ have formed, with crusts. Sometimes, though very rarely in this form, and only when the action is very acute, the inflammation proceeds to the extent of suppuration, forming abscesses; the matter in such cases being surrounded by a fibrous cyst, does not constitute diffuse suppuration, which condition is met with in a more serious variety of erysipelas. Although abscess is comparatively unusual, as an immediate result of this simple form of the disease, it is by no means uncommon for persons of a feeble and irritable constitution to have inflammation excited in a part recently the subject of erysipelas, or in its immediate neighbourhood, and for that inflammation to go on to the formation of abscess, requiring very early and free evacuation, in order to prevent destruction of tissue.

Sometimes the inflammation suddenly disappears, and presents itself in some other part of the external surface, constituting erratic or ambulant erysipelas; and sometimes, although more rarely, its sudden disappearance is followed by asthenic inflammation of some internal part, constituting metastatic erysipelas.

Causes.—The causes of erysipelas are various, and sometimes very obscure. The chief predisposing causes are intemperate living, especially addiction to spirituous liquors, unwholesome or insufficient nourishment, the bilious and irritable temperaments, the gouty diathesis, previous disease, general cachexia, low spirits, anxiety, the feeble, plethoric, and leucophlegmatic habits, disordered condition of the biliary and digestive organs, certain seasons of the year, more especially, spring and autumn, irritability or tenderness of the skin, feeble capillary circulation, previous attack of the disease, and in females certain periods of life, as that of menstruation, and that of the cessation of the catamenia. Of the many exciting causes some act locally, as wounds, contusions, trifling injuries, surgical operations, abrasions of the cuticle, irritation caused by morbid secretions, or by leech-bites, or by cold, or by friction of clothes, or by acrid or irritating substances of any kind, or by inflammation of the skin, from whatever cause proceeding. Of the exciting causes which originate in the system itself, and of those which act on the system generally, some are errors in diet, violent mental emotions, suppression of accustomed secretions or discharges, living in an unwholesome atmosphere, more especially in cold, damp, stagnant situations, atmospheric vicissitudes, impure air from the crowding together of patients in hospitals, contagion, and particular conditions of the air, in consequence of which it occasionally assumes an epidemic character, and is in such circumstances usually very severe and frequently fatal.

Erysipelas no doubt comes on in many instances without any obvious cause, but that it often spreads by means of contagion has been proved

by incontestable evidence. There seems also to be good ground for believing that erysipelas originating in some common cause, and erysipelas induced by local causes may spread by means of contagion. Most of the French authorities deny that erysipelas is transmissible by contagion; but that it is so, facts recorded by Dr. Wells, Dr. Stevenson, Mr. Arnot, Dr. Gibson, and Mr. Lawrence, in various interesting papers published by them on this subject, furnish most conclusive evidence, and set this question at rest. Many other cautious observers have arrived at the same conclusions on this subject as the authorities I have mentioned.

PHLEGMONOUS ERYSIPELAS.

This disease, although met with at all periods of life, and in all parts of the body, is much more commonly found in young and plethoric than in elderly persons, and more frequently in the extremities than in the other regions of the body. This is a very dangerous form of the disease, especially when it occurs epidemically, or from infection. Both the local and constitutional symptoms are severe; the inflammation not only has its seat in the skin and subcutaneous cellular tissue, but frequently extends also to the deeper portions of cellular tissue between the muscles. To make the description of this disease more clear, we shall adopt the arrangement of those authors who divide it into three grades, differing from each other in the degree of their intensity.

In the first grade, after rigors, anxiety, and other symptoms of constitutional disturbance, soon followed by stinging pain, tingling, redness, and a feeling of heat of the inflamed part, tumefaction of rather a hard character takes place, occasioned by the integument being raised up by swelling of the subjacent cellular tissue. After pressure with the finger, the redness returns more slowly than in the simple and superficial form of erysipelas. If about the fifth day, the skin is observed to be less red and tense, and to be covered with furfuraceous scales, and the subsidence of the swelling shows that the subcutaneous cellular tissue is beginning to regain its usual state, the phlegmonous erysipelas will end in resolution. But if, on the contrary, the pain at this stage becomes pulsatory, suppuration is the inevitable result, the matter forming into an abscess of healthy character, the opening of which is usually followed by the speedy healing of the part.

In the second grade, both the constitutional and local symptoms are much more severe; the disease occupies a large extent; at a variable period, but generally not before the fifth nor after the ninth day, purulent collections form beneath the skin or between the muscles, and, on their being opened, gangrenous masses of the cellular tissue are discharged along with the matter. Often, instead of abscesses, there is extensive sero-purulent infiltration into the cellular tissue. There are many sources of danger in this variety, some of which are great irritability of the stomach and bowels, exhaustion from diarrhoea or from extensive suppuration and disorganization of the cellular tissue, severe nervous symptoms, contamination of the blood from absorption of the morbid secretion of the affected part, or combinations of these conditions.

In the third grade, the constitutional and local symptoms are still more intense from the commencement ; the skin is tense, shining, and of a dark dusky red, and only retains, for an instant, the impression made by the finger ; the swelling is diffused, very great, and intolerant of pressure. About the fifth or sixth day, the skin loses its sensibility, assumes a violet tint, and becomes flaccid and covered over with phlyctenæ containing a reddish serosity, and, soon afterwards, sloughs are formed along with ichorous suppuration, destruction, and suppurating boils in the surrounding cellular tissue. This is what some authors call gangrenous erysipelas. In the most favourable cases, after the sloughs are detached, the subjacent parts take on a healthy action, and, after a considerable time, the part granulates and cicatrizes : but most frequently, from absorption of matter or inflammation of veins, or some affection of the brain, stomach, or bowels, the patient sinks, the precursor of death being the symptoms of the worst form of adynamic fever.

ŒDEMATOUS ERYSIPELAS.

In this form the skin is smooth, shining, and of a pale red colour, which, in some instances, inclines somewhat to a yellowish brown ; the heat and pain are less than in the other forms ; the swelling is considerable, and gradually extends ; it leaves the impression of the finger as in anasarca, and from this circumstance this variety has received its distinctive appellation. Vesication is less common than in the other varieties, and, when it is present, the vesicles are small and numerous. The inflammation is of a subacute character, and gives rise to serous effusion ; in some situations it is apt to result in gangrene, as when it occurs in dropsical limbs from excessive distension, or when punctures have been made to allow the fluid to drain off. To diminish the risk of the occurrence of gangrene, in such circumstances, some have judiciously allowed the fluid to escape by numerous punctures with a needle, rather than by incisions.

This form of erysipelas is in degree intermediate between the simple and phlegmonous, and most commonly presents itself in persons of a debilitated constitution, and very frequently in those who have a tendency to, or are affected with, dropsy. The infiltrated limbs of dropsical patients, the scrotum in men, and the genitals in women, are the most usual seats of œdematous erysipelas ; and, of all the results of this variety, gangrene is the one most to be dreaded, and is indicated by severe pain, and a red, glossy state of the skin passing into a leaden or lurid hue.

BILIOUS ERYSIPELAS.

Antecedent disorder of the digestive and assimilative organs is more or less evident in all the forms of erysipelas ; but in this form symptoms of bilious derangement, both before and during the attack, constitute the most prominent features. In such cases, the local symptoms are far from urgent ; the redness partakes much of a yellowish hue, and all the local signs indicate but a slight grade of inflammatory action. The constitutional symptoms also exhibit a very moderate degree of the inflammatory type ; the principal being nausea, bilious vomiting, loathing

of food, thirst, loaded tongue, a yellowish tinge of the body, and other manifest signs of disordered secretions in the *prima via*.

ERRATIC ERYSIPELAS.

The peculiarities of this form are—that it invariably presents itself in persons of a feeble or debilitated constitution, that the constitutional symptoms precede and attend the attack, and that they are much more of the asthenic than of the sthenic character, the symptoms of debility usually becoming very apparent; that the local symptoms are even less severe than is usual in ordinary cases of simple erysipelas; that, in most instances, exfoliation is the only effect remaining, and that the inflammation spreads from one part to another by continuous unbroken extension, the circumference of the inflamed part being always distinct, so that it is very evident where the inflamed and unaffected parts of the skin join each other.

PERIODIC ERYSIPELAS.

The peculiarity of this form is not merely that it returns, but that it is sometimes strictly periodical, returning more frequently (so far as my observation has enabled me to form an opinion) to the parts which were previously attacked; in some instances it has been found to be periodical in return, and universal in extent—that is, extending over the whole body; an example of which occurred in the experience of Mr. Maul, of Southampton, in the case of a lady who had several attacks at intervals of two years. In some instances the attack is monthly, at the time the catamenia should appear. This form of erysipelas is, I believe, most frequently met with in females of a weak and chlorotic habit. I have a patient who, for some years, had a return of it every six weeks, but got over the tendency by residence in the country, and the use of suitable remedies for the improvement of her general health and strength. I know an instance of a man who had for years an attack every two months. In both the last-mentioned cases, the head was the part attacked. One man, whose case I remember, had an attack regularly twice a year, and another every spring. The local symptoms, so far as I have had opportunity of observing, are not very severe, and rarely give rise to more than œdema of the cellular tissue, and exfoliation of the cuticle. The constitutional symptoms are both antecedent and attendant.

TREATMENT OF ERYSIPELAS.

From what has been stated regarding the various forms of erysipelas, the different states of the system in which they take place, and the varieties, both as to the degree of the inflammatory action, and as to the degree and type of accompanying fever, it must be very clear that it will be necessary to modify the treatment according to the particular circumstances of each form and case. Some cases require little treatment beyond rest, suitable regimen, and a proper attitude of the inflamed part; in some, purging and the antiphlogistic regimen are needful; in some, local remedies of a decided character must be joined to general antiphlogistic treatment; while others are attended with so much of a

typhoid type as to require the use of remedies of a very different nature. It has been well observed:—"In some instances large depletions are required; in others, moderate or local depletion only is advisable; and, in many, depletion is most injurious, the most energetic tonics being often indispensably necessary." Whilst the disease thus requires, from the very commencement, most varied and often opposite modes of treatment, it frequently, also, demands an almost equal diversity at different stages of its progress.

In simple erysipelas, the general treatment in slight cases consists in the observance of the antiphlogistic regimen, and the exhibition of mild purgatives, together with rest, cool air, and the maintenance of a proper attitude; but in more severe cases, emetics, purgatives, and antimonials are to be employed, and, in some instances, early general depletion. With reference, however, to depletion, great regard must be paid to the powers and habits of the patient, the stage of the disease, and the prevailing character of the epidemic. Of the many cases which have come under my own observation, in comparatively few have I thought general bleeding necessary, or at all likely to be serviceable; and, except in some very severe cases of erysipelas in the head and face in young and vigorous persons, I very rarely indeed resort to it. Even in such cases, and in others where, from the exceedingly acute character of the symptoms, depletion may be deemed prudent, it should be employed with much circumspection; for however strong and hard the pulse may be, or however great the heat and the urgency of acute inflammatory symptoms, there is soon, in most cases, a tendency to asthenic vascular action and deficiency of vital powers. It is, therefore, judicious in most instances, to rely on other means for allaying excited action, and to resort to bleeding only when it seems absolutely indispensable. In most cases, rest, an emetic, mercurial and other purgatives, followed by antimonials, and aided of course by suitable regimen, fulfil the desired indications, which are to correct the secretions in the alimentary canal, to promote the secretions generally, and thereby to diminish inflammatory action and febrile excitement. As the indications of treatment often alter very quickly, cases should be watched with the greatest care, and the treatment changed, if symptoms of debility present themselves. If any doubt exist whether it be desirable to administer decided stimulants, beef-tea may be given, and four or five grains of carbonate of ammonia every two or three hours; and if the symptoms should not improve, then wine may be administered, and the bowels regulated by mild aperients, but not by drastic purgatives.

The following extract from Mr. Liston, as to the means recommended for subduing inflammatory action in erysipelas without resorting to bleeding, will be perused with interest:—

"The exhibition of the extract of aconite in this and other inflammatory affections, is often followed by great abatement of vascular excitement, so that the necessity for abstraction of blood is done away with. The medicine may be given in doses of half a grain in substance, or dissolved in pure water, and repeated every third or fourth hour. The sensible effect is relaxation of the surface, and frequently profuse perspiration; the arterial pulsations are diminished in frequency and force.

The extract of belladonna, in doses of $\frac{1}{8}$ of a grain, may then be substituted with great advantage, and often with the most extraordinary effect upon the disease."—Liston's "Elements of Surgery," Second Edition, p. 61. *Erysipelas*.—For report of cases of erysipelas thus treated, see "Reports of North London Hospital," contained in the "Lancet" of 6th and 13th of February, and 16th of April, 1836.

Local treatment.—In mild cases no local treatment is required, beyond rest, and an attitude favourable to venous return. In others local applications are useful. Of all the applications in use, my experience leads to the conclusion, that the most generally grateful to the feelings of the patient, and the most useful are warm opiate fomentations, or opiate and lead lotion, applied as warm as the patient can bear them, and as long as he finds them pleasant to his feelings. Sometimes, though very rarely, warm applications are painful; and then I do not hesitate, if the erysipelas be in the extremities, to use the above applications cold, and if they give relief, to continue their use as long as they prove a comfort to the patient.

In more urgent cases, when the action is very acute, I have, together with the use of warm applications, adopted, with the happiest results, the mode of proceeding which was proposed by Dobson, and has been much and deservedly praised by many, namely, local depletion by numerous small punctures, rapidly made with a fine lancet. The punctures should extend only into the true skin, and should be made rapidly. Of the advantages of this proceeding, in acute cases, I can speak in the strongest terms, patients having often expressed themselves grateful for the relief it has afforded. Other local remedies, used in many cases with much advantage, are, brushing over the part with a strong solution of the nitrate of silver (as recommended by Higginbotham, and practised by many), or lightly touching the inflamed surface with the lunar caustic in substance. The former mode is that which I have usually preferred, and my experience leads me to speak very favourably of it, especially in erysipelas of the extremities. After brushing over the part with a strong solution of the nitrate of silver, dusting the surface with flour or magnesia, keeping it fomented with warm opiate, or lead and opiate lotions, or applying them cold, when warm applications are not grateful, are all proceedings from which, in my own experience, I have seen the happiest results. I am satisfied from my own observation, that Higginbotham, Jobert, and others, were fully justified in speaking so strongly as they have of the advantages of using the nitrate of silver as a local application in the treatment of erysipelas. Of the advantage of keeping the part covered with mercurial ointment, as proposed by Little and Dean of America, or of the application of a lotion, or ointment of the sulphate of iron, in the proportion of a drachm of the sulphate of iron to a pint of water or an ounce of lard, as recommended by Velpeau, principally in cases where there are no vesications, and where the inflammation is superficial, I can say nothing from my own observation. To the use of blisters, first recommended by Dupuytren, I have *rarely* resorted, and to bandaging *never*, except as a means of support when all inflammatory action has ceased; but some continental surgeons have adopted a proceeding, which, so far as I know, has never been followed

in this country, and which must surely be attended with great risk, namely, bandaging from the very commencement of the attack, even when the action is acute.

In phlegmonous Erysipelas, the constitutional and local treatment, in the first instance, differs in no respect from that proper for severe cases of simple erysipelas; but it must be strictly kept in view, that whatever may be the activity of the symptoms in the early stage, the general powers are weak, that the disease not unfrequently occurs in those whose powers are naturally feeble, or in persons advanced in life, and that the disease, although accompanied with excitement in the early stage, is afterwards marked by impaired energy, so that if the powers of the patient be greatly exhausted, he will be in the greatest possible danger of sinking under the process of suppuration and sloughing. The most important part of local treatment is the employment of incisions, which, though suggested centuries ago, was first practised in this country by Mr. Copland Hutchison, and has been strongly recommended by him, by Mr. Lawrence, and by many others, and is well worthy of general adoption. Mr. Hutchison recommends that the incisions be made about an inch and a half in length, from two to four inches apart, varying in number according to the extent of surface occupied by the disease. Mr. Lawrence recommends, in preference to numerous incisions, one or two long incisions in a direction parallel to the axis of the limb. Much difference of opinion has prevailed, as to which of these recommendations should be followed; but, on this point, the judicious course surely is for the surgeon, while he is careful to confine incisions to parts where the erysipelas has the phlegmonous character, and, avoids all unnecessary division of parts, to proportion both the number and the depth of the incisions to the extent of the inflammation; and a very important rule is to divide fasciæ, provided the inflammation extend beneath them. The treatment by incisions is adopted at different stages of the disease for the attainment of different objects. At the beginning of the disease it is employed with great advantage, and is often very quickly followed by relief of the painful tension, and a corresponding diminution of the inflammatory action, thus preventing the occurrence of suppuration and sloughing. In short, suffering and tissue are both spared by the energetic adoption of this proceeding at an early stage. The local depletion is useful, the liquor sanguinis is allowed to escape before its disorganization has taken place, and disastrous results are averted. At a more advanced period of the disease, incisions limit the extent of suppuration by opening a way for the evacuation of matter, and still later, they afford the readiest outlet to matter and sloughs. At this advanced period, however, the incisions must be made sufficiently deep to reach the whole of the infiltrated and gangrenous structures; otherwise they cannot fulfil the important indications for which they are employed. Fomentations, in the first instance, and afterwards poultices, should be applied over the part. The patient should be watched, until all bleeding has ceased, as it may be necessary to resort to some proceeding, such as elevation of the limb, or slight pressure for some time, to prevent the hemorrhage from becoming excessive and injurious.

The general strength requires to be kept up by generous diet, wine

and other suitable means, during the severe trial to which it is subjected under the process of suppuration and granulation.

In oedematous Erysipelas the constitutional treatment, in the first instance, consists in promoting a healthy condition of the secretions, by the employment of mild aperients with suitable regimen, and subsequently in improving the general health and strength, by the use of a light, nutritious diet, and by all the means suitable and available in the circumstances. In most instances, as the case progresses, quinine will be indicated. The local treatment consists of rest, elevation of the affected part, warm fomentations, small punctures to allow the escape of serous effusion, and, at a not very advanced stage of the disease, support by means of bandages.

In bilious Erysipelas, if the head be not severely affected, and the disease unattended with much pain or tenderness at the epigastrium, an emetic given at the commencement of the attack is usually of service ; after the operation of which a smart dose of calomel, followed by smart purgatives and diaphoretics is of great benefit. The subsequent constitutional treatment must be regulated according to the character of the disease, the states of general and local vascular action, and the condition of the vital powers. If there be much tenderness of the epigastric or hypochondriac regions, together with nausea or vomiting, local depletion in the vicinity, and afterwards blisters or sinapisms, are of essential service. Little local treatment is required beyond rest, and an attitude favourable to venous return ; the local, as well as the constitutional symptoms, being chiefly combated by internal remedies.

CHAPTER III.

WOUNDS.

THE term wound, in the language of surgery, signifies a recent solution of continuity in the living structures induced by some mechanical cause.

Classification of Wounds.—Of the various divisions which have been made, an important one is the following, viz. ;—wounds of the head, neck, thorax, abdomen, and extremities. The peculiarities of symptoms, dangers, results and treatment depending on situation, will be mentioned in other parts of this work, where the affections of the particular regions are described ; but, in the present chapter, we shall adopt the classification into incised, lacerated, contused, punctured, gunshot, and poisoned.

Various modes of healing.—The various modes in which wounds heal, may be enumerated as the processes of adhesion, granulation, and incrustation.

1. Adhesion—union by adhesion—union by adhesive inflammation, and union by the first intention, are the synonymes by which this mode of healing is referred to. For a description of this process, the reader is referred to the section on the results of inflammation, where, under the head of exudation of coagulable lymph, the opinions entertained regarding this mode of healing are mentioned. The conditions favourable for this mode of healing are—clean surfaces, unimpaired vitality, entire cessation of bleeding, perfect coaptation, exclusion of air, light dressing, and only a very slight grade of the inflammatory process. The treatment for adhesion will be afterwards considered.

2. Granulation is the mode of healing usually to be promoted when adhesion fails. The little conical eminences which form on the surfaces of suppurating wounds are named granulations, from their granular appearance, and serve for filling up the cavities and bringing together the edges of wounds, and uniting them by what is called the second intention.

As the processes of granulation and cicatrization have been already fully described, and as the treatment will come to be afterwards considered, it seems necessary in this place only to mention that this is the suitable, and indeed the only practicable mode of healing, when the wound is of such depth and extent that it is impossible to place or retain the surfaces in coaptation ; when apposition is prevented by the presence of coagulated blood, or other foreign matter, which cannot be removed ; and also when, in consequence of prolonged exposure to the atmosphere, or of any other cause, such as contusion, the inflammatory process has been made to reach the suppurative grade.

3. The incrusting or "modelling" process, better known by the familiar, though less euphonious name of "scabbing," is best adapted for wounds presenting a superficial denuded surface, perhaps of considerable extent, but of little depth. It comes into operation when, there not being enough of inflammation to induce suppuration and granulation, or when, the vascular action of these processes having greatly subsided, a crust is formed on the surface of the wound by the drying, in the former case of coagulated blood or fibrin, and in the latter of fibrin and pus commingled. The crust may also be formed artificially, its use being to exclude atmospheric air, protection from the stimulus of which is essential to this process. Beneath this covering, new matter is added on the surface of the wound, raising its level, if depressed, and skinning it over when nearly on a plane with the surrounding integument; but the exact steps of the process are not fully ascertained. There is no suppuration, but merely a little serous discharge, oozing from beneath the edges of the crust. The cicatrix, when at last exposed, on detachment of that temporary covering, is more uniform, more similar to the original parts, and less liable to contraction, than a cicatrix obtained in any other way. If the inflammatory action increase during the process, suppuration ensues, and pus accumulates under the crust, raising it up and causing painful tension, and thus suspending, for the time at least, farther advance of the modelling process. Wounds heal very readily by this mode in the inferior animals, there being in them much less inflammatory tendency than in man. This mode of healing is most suitable for superficial wounds exposing a single surface, to which none other can be applied, provided there is no contusion of tissue, and little likelihood of inflammation. In deep wounds of uncomplicated character, the sides of which can be approximated, adhesion is more applicable and certain; while in a deep wound, attended with loss of substance, so that coaptation is prevented, or in one of any form accompanied with much contusion, which must be followed by considerable inflammation, granulation offers the most available cure.

The crust, if not naturally formed, may be supplied artificially by covering the surface with lint, which soon becomes soaked with the oozing blood, and on drying, hardens into a strong, well-adapted covering; or the crust may be furnished by gently pencilling the surface with nitrate of silver, which coagulates the secretion. A piece of gold-beater's skin should be applied over, and for a short distance around, the thin pellicle thus formed by the lunar caustic, to prevent its premature cracking and detachment. Or, the crust may be formed, as Professor Miller recommends, by using a "thick semifluid solution of gum tragacanth," which is laid uniformly over the surface, where it soon dries, forming an unirritating, transparent, and effectual covering from the atmosphere, which covering can easily be repaired at any part when necessary, and which, should undue vascular action set in, is softened and set loose by the discharge to which the excess of inflammation gives rise. In the absence of the tragacanth solution, ordinary mucilage of gum acacia would form a similar, though probably a more brittle, and therefore inferior, pellicle. The part should be kept at rest, and, still further to assist in restraining local action, the antiphlogistic regimen

should be enjoined. When the modelling process¹ fails, the treatment for granulation is to be instituted.

The permanent tissues of repair.—With regard to the repair of injuries, it is known that in healing, the lesion of some textures is effaced by a reproduction of similar tissue, while the injury of other parts is repaired by the formation of a tissue less highly organized. Osseous and cellular tissue may be reproduced, and minute nervous and vascular filaments are formed in the connecting substance. The development of blood-vessels for granulations, or for superficial deposits of lymph, adhesions, or the like, has been referred to in the chapter on Inflammation, and the views entertained by many regarding their formation, have been mentioned; but in addition to the opinions already brought forward, it is proper to state, that, according to Mr. Paget, their development is always effected by the projection of *culs de sac*, commencing as mere dilatations, from a capillary arch passing close to the adventitious structure. These coscal diverticula, crowded with corpuscles, are prolonged in a definite manner, towards and into the new tissue, so that they meet and adhere; the double partition formed by apposition of their closed extremities gives way, and a new capillary arch, transmitting blood, is formed. Fibrous tissue is the medium of repair in wounds of cartilage, in the cut extremities of which, however, bone is sometimes deposited. Muscular fibre, when divided, is never reproduced, cellular and fibrous tissues forming the new bond of connexion, which gradually contracting, in most instances, draw the retracted ends of the muscle at last into pretty close apposition. Nerves, when divided, if their cut extremities be in contact, rapidly unite, but with some confusion of function, apparently from the precise continuity of individual fibres not being accurately restored. Even when a considerable interval has occurred between the ends, union has been effected, in the first place by material similar to that effused after wounds of other soft tissues; but, in time, nerve-fibres become developed within this substance, probably by prolongation from the cut extremities, between which they form a communication, partially restoring the functions of the nerve. Not less, it is believed, than two years will suffice for the accomplishment of this process. There is “no example in which the nerve or ganglia corpuscles have been reproduced.” The repair of wounds differs somewhat according to their amount of exposure.

In an open wound healing by granulation, all the parts become more or less matted together, but a subcutaneous incised wound, as practised on tendon, and properly treated, is much better regulated in its cure, and motion becomes free as before. The end of the tendon connected with the muscle retracts, and thus lies surrounded by healthy uninjured structures, quite removed from the site of the external wound. Liquor sanguinis is effused, and collects in greatest quantity, in that part of the sheath where there is most space, namely, that part vacated by the retracted tendon. The serum is absorbed, and the fibrin coagulates. In a few hours, those parts of the wound which are in coaptation, including the opening in the skin, subjacent cellular tissue, and sheath of

¹ So named, it is said, because the new matter is added to the surface of the wounded part, so as to restore its original formation or model.

tendon, have quite healed, but within the sheath, in the space between the ends of the tendon, fibrin exists in large quantity, chiefly derived from the muscular extremity of the tendon, which is the better nourished. By the usual process this becomes organized, and supplied with vessels. "About the tenth day," says Mr. Paget, "it is paler again, seemingly less vascular, and distinctly filamentous." These minute threads run on for some little distance, between those of both extremities of the original tendon, interlacing, and gaining a very firm connexion. In two or three weeks, the cure may be considered complete, continuity being quite restored, though still, for some little time, the new structure and its connexions are scarcely so strong as they ultimately become.

They equal, in this respect, at least, any other part of the tendon, and, indeed, become quite undistinguishable from it. The cicatrix, after a wound, progressively improves in texture; new cuticle, or a structure identical with it is formed; but in the fibro-cellular tissue beneath, which occupies the place of the dermis, papillæ, when formed at all, are few in number, and imperfectly developed. After the lapse of several months, occasionally of more than a year, elastic tissue, similar to that of the original integument, but in very sparing quantity, is sometimes discovered.

INCISED WOUNDS.

Incised wounds are such as are inflicted with a sharp cutting instrument. The form of wound presents regular and smooth-cut surfaces, and is consequently best adapted for healing by adhesion. The principal danger is from primary hemorrhage, which is greater in this kind of wound than in any other.

The treatment of wounds.—The treatment of wounds varies according to their nature, and the mode of healing desired. In this department of practical surgery, a great and salutary revolution has been effected within the last seventy or eighty years. This change had, for many years before the period above mentioned, been occasionally advocated by individuals, whose efforts, though at the time isolated, and apparently little appreciated, no doubt tended to the introduction of a more enlightened system. Thus Paracelsus, who flourished from 1493 to 1541, and who was after Hippocrates, the first who advocated simplicity in the treatment of wounds, plainly asserted, that, in the healing of injuries, nature is supreme, and that the office of the surgeon is merely to protect the *vis medicatrix Naturæ* from hindrance or interruption. In 1542, the application of water-dressing to wounds was recommended in a paper by Blondus, published at Venice. But, probably, the first occasion, on which public attention was at all aroused, was by the cures, then deemed wonderful, accomplished at the siege of Metz, in the year 1553, by an empiric named Doublet, who employed linen dipped in pure water. In his practice its value was supposed to depend on certain charms and incantations pronounced over it. Shortly afterwards, Paré, the father of French surgery, adopted the water-dressing without the mummeries of incantation. Writers followed at intervals. The French military surgeons, Barons Percy and Larrey, in their campaigns, also proved its value. The late Dr. Macartney, in Ireland,

ardently inculcated the use of water-dressing, and, to his successful exertions, much of the general adoption of that method of treatment is attributable. Very much is due on the same account in Great Britain to the late Mr. Liston, who, in his writings and practice, very strongly inculcated simplicity in every department of surgical practice: while eminent surgeons, yet alive, might be cited, who have contributed not a little towards obtaining for the simple and cleanly water-dressing, its present universal estimation. Even when adhesion is not desired, or attainable, the same application used warm, has, in the practice of very many, superseded the employment of the poultice.

The treatment for adhesion—with reference, chiefly, to incised wounds, comprehends *four* important indications, namely, to arrest hemorrhage—to remove foreign matter—to effect and maintain coaptation—and to guard against excess of vascular action.

The *first* indication is fulfilled, by aspersion of cold water, if mere oozing exists; or, by the ligature, when a distinct artery is seen pouring forth its contents. The ligatures, one end of each having been cut off near the noose, are brought out between the lips of the wound, by the shortest route; and if numerous, are arranged without entanglement into one or more bundles. These should, when otherwise convenient, leave the wound at its most dependent part; so that the slight purulent secretion, which is pretty certain to occur in their track, may find the most direct and easy exit, and, by at once escaping, not interfere mechanically with the process of adhesion in other parts of the wound. In amputations of the extremities, they are usually brought out at the angles of commissure between the flaps. The method of cutting off both ends of the ligature, and leaving only the knot, is now restricted, by almost all surgical authorities, to those cases in which the wound has no chance of uniting by the first intention.

The *second* indication, which is to remove all foreign matter, including coagulated blood, should be attended to as soon as active bleeding has been suppressed. Were its fulfilment neglected, adhesion would in consequence be prevented.

All oozing having been completely arrested, foreign matter removed, and the surface of the wound having taken on a glazed appearance;—the *third* indication,—namely, to effect and maintain coaptation, should next be proceeded with. Such are the conditions which render coaptation advisable; and with regard to the means employed for effecting it, they are position, plaster, sutures, when necessary, and, in some particular circumstances, carefully adapted pressure.

The position should be such as will best relieve tension of the muscles and integuments, and obviate venous congestion. A greater amount of relaxation is necessary in some wounds than in others. As muscles are the principal agents in causing retraction, and in preventing easy coaptation, the general rule is to put the limb or part into the position that would be given to it by the natural contraction of the wounded muscle. When muscular fibres are cut transversely, there is much greater retraction, and consequently more necessity for the observance of a position that will secure relaxation, than when the wound runs parallel to, or between them, in which case relaxation might be carried

too far, by making the sides of the wound bulge loosely, and thus preventing accurate coaptation. In such cases, the parts should be laid so as sufficiently to relieve tension, without permitting undue laxity. In amputation wounds of the limbs, where little relaxation is necessary, more than is already present, elevation, to such a degree as to prevent congestion, is the chief point of consequence with regard to position.

Of retentive appliances, *plaster* is one of the most generally useful; and of the various kinds of plaster, the best, though unfortunately also the most expensive, is that which was introduced into practice by Mr. Liston, and known by the name of isinglass plaster. It consists of gauze or silk, which, being stretched out, is frequently coated with a film of isinglass, until the adhesive layer be of the requisite thickness; after which the other side is turned up and varnished with boiled oil. Its advantages are these,—the isinglass is perfectly non-irritating to the sound skin or its cut margins; the oiled gauze is transparent, and accordingly does not conceal the state of matters below; it is very easily applied, having only to be moistened with warm water; it soon dries, becoming firmly adherent; and the impervious nature of its varnished tissue prevents any moisture from the outside detaching it. When the wound is discharging, the plaster becomes loosened immediately over the edges, and for a little way beyond; but this is really advantageous, as it favours free escape of secretion from between the lips of the wound; and the loose, central portion stretching a little, allows room for the slight tumefaction which generally exists in some degree, when any discharge is being poured forth. On the other hand, cheapness is the sole recommendation of the common plaster, composed of *emplastrum plumbi*, with resin added to make it sufficiently adhesive. From the nature of the latter ingredient, this plaster is irritating to the skin, and so favours inflammation and erysipelas. It does not adhere firmly when the skin is at all moist; the calico on which it is spread being opaque, hides from inspection the parts beneath; and when any ill-conditioned foetid pus comes from the wound, the plaster, if carelessly prepared, becomes blackened by the formation of sulphuret of lead, which smears the parts beneath; in the removal of which layer, as cleanliness demands, more washing and sponging are required than can be beneficial to the delicate margins of the wound. By slow boiling, however, for double the usual time, plaster may be made pretty adhesive without the addition of the irritative resin.

The strips of plaster, varying in breadth according to the size of the lesion, are applied at intervals about as wide as the strips, while the assistant carefully holds the parts in the most favourable position for coaptation, and gently presses the cut surfaces and edges into apposition. The intervals left between the strips of plaster permit the escape of any secretion of serum or of pus, if afterwards formed; and, it is in these intervals that sutures and the extremities of ligatures are, when employed, to be placed. The slips should be long, so as not merely to hold the edges in contact, but, by their adhesion to an extensive surface, to keep the parts well together. In longitudinal wounds of the extremities, however, they should not be so long as completely to encircle the limb, as they would then constrict it, prove hurtful and pro-

vocative of inflammation and œdema, by obstructing venous return, and by rudely opposing the slight swelling which takes place in every large wound, even although adhesion be attained.

Instead of isinglass plaster, strips of linen dipped in, or spread with collodion, have lately been employed. This substance, made by dissolving gun-cotton in ether till the solution be of a syrupy consistence, dries very rapidly when spread out, in consequence of the evaporation of the solvent; and in so doing, it contracts and tightens, leaving a transparent and colourless layer which adheres very firmly to the skin, and is unaffected by and impervious to any of the ordinary fluids naturally or artificially present about a wound. To procure its thorough adhesion, the skin must be quite dry at the moment of application. In cutaneous wounds, after the strips are dry and adherent, if there be no oozing of serum from the cut, a little collodion may be smeared in the intervals over the margins, by which means the edges will be preserved in contact, and protected from atmospheric irritation. The collodion may be tinted any colour, and it is worthy of remembrance, when large quantities of it are used, that it is highly inflammable, and that the dry substance left by the evaporation of the ether, is quite as combustible as the gun-cotton before its solution, except that its now more compact and solid form renders combustion or explosion less rapid than in its original fleecy state. A substance closely resembling collodion in its properties and capabilities of application is prepared by dissolving certain proportions of gutta percha and caoutchouc in chloroform, and is used in precisely the same manner. A third substitute for the isinglass and common adhesive plaster has lately been employed. It consists of a thick, semifluid solution of gum-lac in alcohol, which may be prepared and kept in a wide-mouthed bottle with a closely-fitting cork. It is more economical than collodion, it is employed in the same manner, and is represented as being quite as efficient. It has, along with the gutta percha solution, the disadvantage of not being like collodion altogether colourless; but it is said to possess, over both these preparations, this advantage, that moderate moisture does not prevent its adherence. All of these solutions, when applied to a raw surface, excite momentary smarting.

Sutures, the next of the retentive apparatus, should not be employed, when it is possible to maintain steady apposition without them. During the first day or two, and before they have cut their way by ulceration through the skin, they certainly act more powerfully than plasters in maintaining coaptation,—one of the essentials for obtaining adhesion; but they also irritate much more, and, if not speedily removed, excite, at least in their immediate vicinity, sufficient inflammation to lead to ulceration, preparatory to their spontaneous extrusion; and the vascular action thus set up in one part of a wound, may extend so far as materially to interfere with or prevent adhesion. Even under the most favourable circumstances, a slight suppuration seldom fails to follow in the track of each stitch; and though, when the action stops here, the general healing of the wound may not be retarded, still the greater marking of the cicatrix, at each of these points, is an additional reason for avoiding their employment when possible, especially on exposed

Fig. 16.



parts. Sutures, then, are to be employed when there is difficulty in keeping the parts satisfactorily in contact by means of plasters; but they should be as "few and far between" as consists with the attainment of their immediate object. They are introduced before the plasters are applied; and on each side, but not over them, the strips of the latter should be placed. For deep wounds, and for those of irregularly shaped parts, the *interrupted* stitch is usually employed (Fig. 15); though, for the former class, the *quilled* suture is sometimes recommended; and for wounds in some situations, as will be explained in a future chapter, the *twisted* suture (Fig. 16) is the best for maintaining coaptation.

The sutures should, in all instances, be removed as soon as it can be done without endangering the separation of the parts. If the structures be lax and easily kept together, they may be cut and removed at a very early period; as soon, indeed, as the plasters have become dry and strongly adherent; but, if there be tension in the lips of the wound, the whole, or some of the stitches, must be allowed to remain until the parts have become somewhat moulded to their new relations, and partially adherent. Again, if severe inflammation attack the wound, the sutures must be snapped and withdrawn, as their presence would only increase the mischief:—they would soon be set free by ulceration, but before this was accomplished, the undue constriction which they must have exerted on the tumefying wound, would stimulate the local action

Fig. 16.



and aggravate the pain.

Instead of the suture, M. Vidal employs a little spring forceps, about an inch and a half in length, to maintain coaptation. Its points are so far blunt, that, though they take hold of the skin, they pierce no more than the cuticle at most. It excites little or no irritation, and, when removed, leaves no mark. Another and smaller forceps, on a similar principle, but only about three-quarters of an inch long, is also employed in Paris. In venereal cases, in which circumcision is there frequently performed, the glans penis is surrounded with, as it were, a corona of these forcipes, the points of which keep the cut margins of the delicate skin and mucous membrane in most intimate contact, and the wound speedily heals with a cicatrix scarcely perceptible.

In many, indeed, in most wounds, no other retentive apparatus than suture and plaster need be employed; but in certain cases, when the wound is very deep, and its sides exceedingly loose,—conditions occasionally coexistent in persons of flabby fibre, and which favour the accumulation of secretions between the parted sides,—it may then be advisable to surround the wounded part with a turn or two of a bandage; under which, but not over the mouth of the wound, a soft compress may sometimes be placed with advantage. The roller, at this early stage, must, however, be applied very lightly; so that it shall merely assist in giving support, and in preserving apposition of every part, deep as well as superficial; and operate more as a precautionary measure to

prevent displacement during any irregular muscular twitching, than as an immediate means of retention. Gentle support—not actual and injurious pressure—is wanted; and the better to avoid this evil, it is well to damp the bandage previous to application; for the dry fibre soon imbibes moisture from the integument or the wound, and, in so doing, grows thicker and shorter, so as ultimately to become much tighter than when applied, or than was intended.

The retentive apparatus having been thus applied, the wounded part is to be laid in a suitable position, combining relaxation and elevation. The latter is the point chiefly to be attended to after amputation; and, for this purpose, the stump or other part is laid on a soft pillow, or any convenient rest, over which, for the sake of cleanliness, is spread a piece of oilcloth, or of thin sheet gutta percha, in order to prevent the parts beneath being soaked with any discharge. Along the margins of the wound, when large, a single strip of soft linen is placed, and kept moist with cold water; but in smaller and more sheltered injuries, this may be omitted. When the wounded part lies beneath the bedclothes, their pressure and heating effect must be prevented by a suitable cradle.

All that now for some time requires to be done, is merely to keep the parts clean, wiping away any fluid secretion from the neighbourhood of the wound, but never actually touching its raw and tender margins. These matters being attended to, the part is to be kept otherwise, as far as possible, at perfect rest.

Supposing all to go on well, the stitches, if such have been employed; are removed at the proper time, as before explained; but the plasters may possibly, in a large wound, require occasional renewal, owing to the fluid secretion trickling down and loosening their dependent extremities, or from their becoming unduly loose as the process of adhesion goes on, and the edges spontaneously approximate more perfectly. When, from any of these causes, it becomes necessary to change the plasters, they should be seized by both their extremities, and raised from each end towards the centre, which overlies the line of wound, and from this lastly they are with gentleness to be lifted. If, on the contrary, the strip were seized at one end, and pulled off along its whole course towards the other, it is obvious that after passing the central part, it would, if at all adherent, be apt to tear away the edge of the wound covered by its last half, from that margin to which its first raised portion had been applied. In renewing plasters, no more than one or two of the old strips, however loosely adherent, should be removed at once, before supplying their place with new pieces; but as each slip is taken away, the vacancy is to be filled up before detaching another. This precaution is necessary, because if all the strips were removed at once, the wound, being unsupported, might fall open, and tender adhesions—the work of several days—be in an instant destroyed. Any necessary moving of the wounded part, whether for correcting malposition, cleaning the support on which it rests, or applying fresh plasters, must be conducted with great care and gentleness.

When ligatures have been employed, some of them will probably be loose by the end of ten days. Accordingly, about the expiration of that period, each ligature, except that on the main artery, which should be

left undisturbed for at least a week longer, may be carefully isolated from the others, and gently pulled by the fingers or forceps. If loose, it will come away immediately; but if the slightest resistance be felt, no force must, on any account, be used to withdraw it; a few days longer being allowed to elapse before it be again tried. The utmost gentleness is to be observed in this proceeding, lest the ligature should be drawn away before perfect occlusion of the vessel has taken place; but with this precaution, it is better to try the ligatures, and remove them when loose, as if left to themselves they might remain in the wound long after they were detached, and thus retard its complete healing.

Perfect healing, after adhesion has progressed favourably for about a week, is often retarded by an œdematous swelling, the result of undue vascular relaxation. In these circumstances, a bandage is to be applied, so as to give support, and exert a moderate degree of pressure. This, however, must neither be severe nor unequally disposed, because in either case it would excite irritation, and the swelling of œdema would soon give place to that of inflammation.

It must always be remembered, that at any stage, however late, excess of vascular action may set in, and prevent the further progress of adhesion, or even destroy the union already effected. It is frequently induced by cumbersome dressings, officious sponging and rubbing of the wound, and by an over-stimulating diet.

The *fourth* indication, which is to repress inflammatory action, is fulfilled, partly by the simple local treatment just detailed, and partly by treatment directed to the system in general. The strict antiphlogistic regimen should be enforced, all stimuli removed, and perfect rest, general as well as local, enjoined. The food must be small in quantity, unstimulating in character, and given pretty cold. In feeble persons, and in individuals at an advanced period of life, the antiphlogistic regimen must, however, be instituted with great caution, and its effects closely watched; but, regarding these and many other points, the surgeon must be guided by the peculiar circumstances of each particular case.

Treatment for Granulation.—Wounds may require to be treated for granulation, either when inflammation has proceeded too far in a case which it was first attempted to heal by adhesion, or when, from the beginning, it was evident that granulation was the most suitable mode of healing, whether owing to loss of substance preventing coaptation, or to extensive contusion, or to the presence of foreign matter which could not be removed; all of which conditions are incompatible with the attainment of adhesion, on account of the active inflammation to which they give rise.

In the former case, that of a wound treated hitherto for adhesion, its edges become swollen, red, and painful. Swelling more deeply seated causes the margins to separate, and purulent matter is soon poured forth. The indication here is to repress inflammation; in fulfilment of which, all sources of local irritation and general stimulation must be withdrawn. Sutures, if present, should be removed, and only a few strips of plaster left, to prevent any unnecessary gaping of the wound, and in many cases they also must be dispensed with. To the parts thus

relieved from every kind of local irritation, warm water-dressings are applied, or a light, soft, moist, and warm poultice, if that application be still employed.

In the second case, where granulation is from the first considered to be the most available mode of cure, the treatment is essentially the same as that mentioned above. The part is elevated, and kept at perfect rest; no sutures are employed, and only a few strips of plaster are used to connect the more loose portions of the wound. Cold water-dressing is applied till oozing of blood ceases; it is then gradually changed to the tepid, and next to the warm dressing, as the vascular action rises, so as to soothe and relax the tumefying wound. When the inflammation proves so active as to threaten gangrene, it must be repressed by local bleeding, and if absolutely necessary, by general depletion, in addition to the antiphlogistic regimen, which, during this stage of acute inflammation, is to be adopted.

In both cases the same point is now reached. Warm dressings are continued so long as inflammation remains active; but as it subsides, the heat of the dressing is gradually lowered until it be again merely tepid, or even cool.

Under this treatment the surfaces, if matters go on favourably, become clean in a few days; granulations spring up, and healing advances. The discharge which, during the height of the inflammation, had been very profuse, and far from laudable, now diminishes in quantity and improves in quality. In these circumstances, the wound, when superficial and broad rather than narrow and deep, requires merely the treatment proper for an ordinary ulcer; comprising the water-dressing, medicated, when necessary, with metallic salts, to stimulate indolent granulations, and the employment of carefully-adapted pressure by a bandage, when necessary to repress oedematous swelling.

But if the wound be deep, without much loss of substance—in fact, such a case as would have healed by adhesion had not inflammation prevented—then, at this stage, when the surfaces are granulating well, and secreting little pus, they will, if placed in mutual contact, speedily cohere, affording a most satisfactory and rapid cure by secondary adhesion. Plasters are employed to retain the parts in apposition, and a bandage, lightly and uniformly applied, is in general necessary to give support. As absolute local rest is necessary for healing, any neighbouring joint, which interferes with this essential condition in the wound, must be prevented from exercising its natural functions, by a splint fastened with a few turns of a roller, or with a buckle bandage applied at two or more points, lightly, so that no oedema may ensue on the distal aspect, and arranged so that neither splint nor bandage shall compress the injured parts, or come in the way of the requisite dressings. Cleanliness is throughout attended to; the actual edges of the wound are not touched, but from all around them the discharge is frequently wiped away with a small dossil of clean lint, tow, or rag, or indeed of anything clean, soft, and absorbent. A good sponge answers well when there is only one wound to dress, because it can then be frequently washed; but, in hospital practice, it would come into contact with all kinds of sores, and would never be sufficiently well or often

cleansed after each time of its employment. On the other hand, the morsel of tow, being of small value, may be destroyed, and a fresh piece employed on each occasion.

The constitutional treatment—which, during the height of the inflammation, comprised at least the antiphlogistic regimen, and sometimes also local or general bleeding, according to circumstances—consists now, while matters are going on favourably, in attention to the secretions, and avoiding, equally, undue stimulation or hurtful abstinence. In individuals of debilitated constitution, and even in persons previously of good health, when the wound is large, suppuration may continue profuse, cicatrization proceed very slowly, and the secondary adhesion fail. Under these circumstances the diet must be full and nutritious, with a due allowance of stimuli. In severer cases this generous regimen must be farther assisted by the exhibition of medicinal tonics. Though the part itself must be kept at rest so that it may heal, yet it may be much benefited indirectly by appropriate general exercise, with the view of strengthening the system.

LACERATED WOUNDS.

Lacerated wounds are produced by a blunt body being driven into and through the textures, or by a moving body becoming attached to a part, and tearing it away. In both cases the edges are ragged and uneven, the parts being torn rather than cut; in both there is considerable straining of the surrounding structures, and in the former an amount of contusion is inflicted by the body entering and passing through the tissues. This dragging and bruising of the parts weaken their vitality. From the depression of the nervous system in severe cases of this nature, there may be little pain. So much, indeed, is this the case, that an arm has been torn off by machinery, and yet the person has for some time experienced little or no pain. There is, in general, also but little hemorrhage, partly because the surface of the wound being irregular, the blood is very apt to adhere and become coagulated; partly because the vitality of the vessel has been diminished by the straining. But the chief reasons why arteries bleed less when lacerated than when cut, are, that when torn the coats do not retract equally, the inner and middle coats contract and retract within the external tunic; the external coat next retracts within the sheath to a less degree, and the sheath forms a conical cavity beyond the outer tunic. These conditions are obviously much more favourable for the arrest of hemorrhage than the uniformly retracted coats of a cut artery. Although the pain may often be slight at first, and although there may be little primary hemorrhage, these wounds are ultimately much more dangerous than those of a simple incised character. They are very apt to be followed by severe inflammation; and, if there be much bruising by sloughing, they are more liable to be followed by severe constitutional disturbance, and by tetanus; and, if gangrene ensue, there is danger of secondary hemorrhage on the separation of the slough.

In the case of a purely lacerated wound, or when contusion, though present, is so only in a very slight degree, adhesion is possible, and ought to be attempted; and if it should fail, from inflammation running

too high, the wound is still as much disposed for granulation as it would have been, had adhesion not been tried. Besides, a part of the lesion may adhere and remain united, even while granulation occurs in the remaining portions.

The *treatment* of those wounds which are purely lacerated in their character, or at least attended with extremely slight contusion, is, with some modifications, the same as that already related as conducive to adhesion. Sutures should, if possible, be still more avoided than in simple incised wounds, and isinglass plaster chiefly trusted to for maintaining coaptation, so as to diminish, to the utmost, all sources of local irritation. Absolute rest of the part, and usually of the whole body also, is requisite. The water-dressing is applied cold or nearly cool, for the latter is usually more agreeable to the feelings of the patient. If the attainment of adhesion be peculiarly desirable, it may be necessary, in addition to the abstraction of all sources of local or general excitement, and the rigid observance of the antiphlogistic regimen, to take blood from the part, or even from the system, in order to keep the inflammation within proper limits. Under this treatment many such wounds heal partially, if not altogether, by adhesion. Should, however, inflammation prove too active, a change should be made to the treatment for granulation.

CONTUSED WOUNDS.

Contused wounds are caused by very blunt bodies passing in a tearing manner through the tissues, inflicting in their passage a large amount of contusion and straining. They are, in general, merely lacerated wounds, accompanied by much contusion; but this complication renders them more dangerous, more tedious to cure, and productive of greater deformity. When the bruising is very decided and instantaneous, there is usually not much pain. This circumstance, however, is merely a symptom of the contusion being very severe; for if it be but slight, the pain may be pretty acute. The primary hemorrhage is seldom considerable; but bleeding may occur to a dangerous extent on the separation of sloughs. In severe cases, there is considerable collapse, and reaction is proportionately violent. Excessive inflammation attacks the wound, and gangrene not unfrequently occurs, sometimes to a large extent, especially in vitiated constitutions. A large sore follows the loss of substance, suppuration is profuse, and may be so prolonged as to induce hectic fever. Or pyæmia may occur, and typhoid symptoms become developed.

The *treatment* of wounds, in which the contused character prevails, is regulated with a view to granulation. The bleeding having ceased, foreign matters being removed, and the wound cleansed, the part should be placed in a position that combines relaxation with elevation, both these conditions being calculated to relieve the supervening local action. Sutures are useless, and the irritation caused by them would be injurious. Even plasters are unnecessary, except when the wound has a strong tendency to gape widely, or when, at some parts, the contusion having been slight, there may be some hope of partial adhesion, on coaptation being effected. Warmth is applied either by means of cloths dipped in

warm water, or by means of a soft, light poultice, in which the bruised part is imbedded. Neither application must be allowed to become dry or cold, but is to be renewed as frequently as may be requisite.

When the inflammatory action runs high, depletion—local and general—may be necessary to repress its violence, and limit the consequent amount of sloughing. But this part of the treatment must always be conducted with the greatest caution; remembering that ere long the system may be taxed to the utmost, in maintaining suppuration from an extensive surface, and which may, by long continuance, induce hectic fever before cicatrization be effected.

During the progress of the inflammation, diffuse abscess occasionally occurs, and must be evacuated by free incisions. As the slough separates, the patient should be watched, lest secondary hemorrhage should occur; and after the separation, the proper treatment instituted. The warmth of the applications should of course be reduced when the process of granulation commences, as the relaxing effects of the heat would then be injurious. Amputation may be necessary when there is very extensive crushing of the soft parts, or comminution of bones; and also when the gangrene is very extensive, accompanied by proportionate constitutional disturbance.

The *constitutional* treatment need scarcely be recapitulated. During collapse, if long persistent, stimuli may be required, yet should be given as sparingly as consists with the attainment of the object for which they are given, and not to such extent as to aggravate the subsequent reaction and its consequences. During the height of the inflammation, the antiphlogistic regimen should be adopted; and, when necessary, local or general bloodletting, according to the violence of the action, but in every case with great caution.

PUNCTURED WOUNDS.

Punctured wounds are produced by the penetration of a narrow and pointed object into the tissues,—usually to a depth disproportionate to the small aperture of entrance. According as the point of the instrument is sharp or blunt, and its blade thin and flat, or thick and bulky, will the injury partake chiefly of the physical characters of an incised wound, or of those of the lacerated and contused varieties; that is to say, the wound has some of the characters belonging to each of these three species, and according as one or other predominates, the lesion is more or less serious. Unless some very important organ has been injured, the shock is less marked in this than in some other kinds of wound; but whenever the weapon has passed far and deeply into any tissues, the lesion must be considered of a serious character, more particularly as it cannot at first be known what parts have suffered, and what have escaped. There may be at the time little primary hemorrhage, although a considerable artery has been wounded, because of the form of the wound being unfavourable to the free exit of blood. In such a case, however, the blood is certain to break out speedily, and even although no large vessel be wounded, there is still the danger of secondary hemorrhage, if there has been bruising to an extent calculated to lead to inflammation and sloughing. Nerves likewise may be *cut, torn,*

or *punctured*, and consequently for this reason, as well as for others, tetanus is more to be dreaded in these wounds than almost in any of the other varieties.

Very violent inflammation usually follows punctured wounds of any considerable depth; not only on account of the mode of their infliction, but also because the blood, which oozes from the surface, does not meet with a ready exit, but remains coagulated, forming a layer of foreign matter, or becomes infiltrated into the soft tissues, chiefly the cellular. Inflammation is further favoured by the probable lodgment of extraneous bodies; perhaps of a portion of clothing driven in before a blunt-pointed weapon, or of the sharp point of a more delicate instrument which has been broken off against a bone that resisted its farther progress. Violent inflammation is pretty certain to follow punctured wounds of synovial and serous cavities, of dense fibrous structures, and of the scalp, in which latter situation it usually assumes the erysipelatous form. When of considerable depth, several layers of aponeurosis are generally traversed; and these unyielding structures, by tightly confining the parts beneath and preventing their tumefaction as vascular action rises, aggravate the subsequent inflammation, while the matter, not finding sufficiently free vent, is very apt to burrow along the muscular interspaces beneath the fasciæ, and give rise to diffuse purulent infiltration of the cellular tissue.

The *treatment* of punctured wounds varies according to the depth of injury, and the amount of accompanying contusion and laceration. When the wound is of small depth, attended with little or no bruising, and is free from foreign matter, adhesion is possible and should be promoted. Till oozing ceases from the external orifice, cold aspersion is to be practised. When no more blood issues, any little apposition required by this form of wound is to be effected, and a piece of isinglass plaster placed over the opening, so as to cover it entirely, or with the exception of the most dependent point. The patient is to be kept quiet, and restricted to the antiphlogistic regimen. Under this treatment, most of these slight wounds heal; but if the case be a little more severe, the cold water-dressing, or a cooling saturnine lotion may be applied; still, however, retaining the morsel of plaster, so as to preserve the actual margins of the wound from irritation, and to prevent the liquid application from insinuating itself along its track. A single layer of moistened lint is employed, but without oiled silk above it, as the object is to encourage rapid evaporation, and procure its refrigerant effect.

In more serious cases the treatment becomes, in a corresponding degree, complicated. Thus if hemorrhage takes place from a wounded vessel, which cannot be reached on account of its deep situation, and the narrowness of the wound—while pressure fails to arrest it, or, owing to the peculiar situation of the injury, cannot be employed—then the wound must be dilated by careful incision to the required extent, and in the safest direction, so as to permit the artery to be tied above and below the point of lesion. Dilatation may also be requisite, when foreign matter has lodged in the wound, the presence of which will be ascertained by learning the mode of infliction, by inspecting the weapon,

or, if necessary, by the gentle use of the probe. The foreign substance may then be removed by a forceps, or any convenient instrument.

It was formerly the custom to dilate every punctured wound by tents and plugs. More recently simple incision was substituted with the hope of transforming the lesion into a mere incised wound, which, as has already been seen, is of a much more simple character. This indiscriminate use of the knife is now justly abandoned, and dilatation practised at this early stage only with a view to permit the ligature of a bleeding vessel, or the removal of foreign bodies; and, at a later period, to effect evacuation of matter, and thus afford relief from tension. The wound being now free from extraneous substances, its edges are brought gently together, and cold water is applied till oozing ceases. Apposition is then effected, and preserved by one or more slips of isinglass plaster; and cool water-dressing applied to prevent undue vascular action.

Subsequently, when pain, tension, and inflammation ensue, and prove severe, warm fomentations, medicated, if necessary, with opium, are applied to soothe and relax the parts. Adhesion not having taken place, the subsequent treatment is adapted for granulation. In cases still more severe, abstraction of blood from the parts around the wound, and from the system, may be necessary to limit the action and sympathetic disorder of the constitution. When deep-seated inflammation occurs, particularly when under dense fasciæ, indicated by severe pain, diffuse swelling and hardness, then early and free incisions are demanded to relieve tension and afford free vent to matter.

The *constitutional* treatment, which in punctured wounds frequently requires to be pretty active, is conducted on the same principles which have so often been referred to in pages immediately preceding, and therefore need not here be recapitulated.

GUN-SHOT WOUNDS.

Gun-shot wounds, the most frequent injuries in modern warfare, are inflicted by shot projected from pistol, musket, rifle, or cannon, by splinters of wood or stone, shattered by an impinging ball, and by fragments of iron, or other substance, scattered around on the explosion of shells. They present, according to the nature of the penetrating body, various degrees and combinations of contusion, laceration, and puncture.

With regard to these injuries, there are many circumstances which require to be understood. A ball projected through the air, proceeds at first with great force and rapidity, nearly in a rectilineal direction; and if it come, during this part of its course, in contact with any portion of the body, it either penetrates and lodges, or passes directly through, or carries the part away, according to the force and size of the shot.

After a time, the ball describes a curve, called the parabola; its velocity diminishes, and it acquires a new motion of rotation on its own axis. In this stage, very slight obstacles deflect it from its course, and should it now impinge against the body, the ball, even though large, may not sweep away the opposing part, but merely be turned aside, rolling over the surface, and inflicting, in proportion to its remaining mo-

mentum, a dreadful amount of contusion. This is indicated by the cold, soft, and flaccid feeling of the part, and its diminished or destroyed sensation. Such is the explanation, as given by Larrey and modern military surgeons, of those cases of violent bruising of the soft parts, fracture of bones, and dangerous or instantaneously fatal concussion of internal organs, by large shot, frequently without laceration of the integuments, or the infliction in rapidly fatal cases, of any outward sign of injury. These accidents were formerly attributed to the "wind of the shot," caused by its passing with extreme velocity close to the body; but they are now with more accuracy referred, as above, to the actual contact of "spent balls."

The aperture of entrance made by a ball, is much smaller than the aperture of exit; and very generally, owing to the elasticity of the integument, much smaller than the shot which actually entered, while its margins are inverted and uneven. The aperture of exit is larger; its edges are everted, and more ragged than the former. When discharged, either at a very short or long distance from the body, a ball enters more roughly, and produces a more ragged wound than when it strikes in the middle of its range. At its entrance, and during the first part of its course through the tissues, its transit is chiefly characterized by contusion; while farther on, and towards its exit, its effect is more purely laceration. In the former part, therefore, sloughing is more probable.

In the stage of diminished momentum, the shot, if small, may also be deflected, when it impinges very obliquely upon the surface; or, piercing the integument, it may proceed beneath it, sometimes along the trunk, or the hollow aspect of a limb during flexion, sometimes partially or completely round either; or penetrating more deeply, it may enter the thoracic or abdominal cavities, and course around their interior circumference, without wounding the contained viscera. It is, in fact, deflected from its straight course, when the obstacles to its direct continuance are greater than to slight deviation. From these circumstances, it happens that the course of balls is very uncertain. A button, or other hard appendage of the dress, and the common articles usually contained in the pockets, have frequently repelled, arrested, or deflected a ball, to the manifest preservation of life. Sometimes, on the other hand, these bodies are forced into the tissues before the bullet.

After penetration, their course is not more certain. Bone, and softer structures, may alter their direction; and the elasticity of the common integument often confines them after passing through denser structures.

A bullet may lodge, or escape, after the most direct or the most devious route. It may lodge immediately beneath the integument, either at the point of entrance; or after passing through towards the opposite aspect; or after coursing on beneath the skin—its direction in this subcutaneous course being indicated by a discoloured mark, commonly called a "weal." It may lodge in bone, in any of the soft tissues, in the interior cavities, in fact in any part, however distant from its point of entrance, after the most direct or the most circuitous and lengthened route. It may escape, by an opening directly opposite to the aperture of entrance, after passing directly through the part, or merely running round beneath the integument; or it may proceed

further in the latter course, escaping near the aperture of entrance, by which it may indeed emerge, so that only one opening is made,—a circumstance which might lead to the belief that the shot had lodged. Under one other condition the same may occur. Thus, sometimes, when the ball, possessing slight impetus, strikes a part of the body covered by dress, it may, if this be thin and tough, force a portion of it before itself into the wound, and that without tearing it off, so forming an involution, or *cul de sac*, in the interior of which the ball lies, and from which it drops accidentally, or is brought away by traction on the remainder of the cloth. In this case, where the wound lies beneath clothing of unbroken continuity, it cannot of course be supposed that the ball has lodged, although there be but one aperture. A leaden bullet, impinging on a sharp edge of bone, may be divided, and a half pass on each side of the opposing bone, each portion emerging by a separate aperture; or one part may escape and the other be detained. The ball may force a portion of clothing into the wound, and both lodge together; or, itself passing by, may lodge further on, or escape.

Perhaps it is no bullet of lead or of iron which enters, but a fragment or splinter, dashed up by the striking of a shot in the neighbourhood, or by the bursting of a shell. Or it may be neither metal, stone, nor wood which enters, but merely wadding, as may occur when the gun is fired at close quarters, and not loaded with any more solid projectiles: for, at short distances, wadding may penetrate many layers of dress, carrying portions along with it, inflicting a ragged wound, and, when deep enough, almost invariably lodging. A single deep and very uneven wound may also be produced by an aggregation of small shot, ere they have proceeded far enough from the gun to have become widely separated.

When there is more than mere contusion, the opening of entrance is of course always present, but that of exit is more inconstant. It may be wanting altogether, as when a bullet lodges; or wanting, at least as a separate orifice, when the bullet emerges at the same aperture by which it entered, either after crossing beneath the integument, completely around the limb, or when drawn out along with an untorn tubular invagination of the dress. The opening may be single, by which the whole bullet, or only half of it, when split after entrance, has escaped; or it may be double, when both portions of the bullet, split on a crest of bone, have emerged each by a separate wound of the integument.

But two bullets may have entered by the same wound, and only one of them have escaped; and though there may be one or more apertures of exit, yet these apertures may have been apertures of entrance to other balls which also have lodged.

The amount of injury varies, of course, according to the parts wounded. Owing to the uncertainty regarding the course of the ball, it is impossible, at first, to say what these parts are; and time alone can show what shall be the ultimate amount of destruction, after inflammation and sloughing to a greater or less extent have occurred. Large vessels may be wounded, while yet sometimes they marvellously escape division, as when a bullet passes between a large artery and its vein,

lying together in close juxtaposition. In these cases, however, the vessels are generally so much bruised, as to slough or ulcerate during the coming inflammation, giving rise to secondary hemorrhage. Important nerves may narrowly escape, or be bruised and divided. Bone may be simply fractured, with or without wound of the integument; yet still not without much contusion, favouring the occurrence of necrosis: or, it may be, extensively comminuted and splintered, or perforated, the aperture thus made being always, in the flat bones at least, considerably larger than the bullet: or, it may be the resisting body in which the ball lodges. Serous or synovial cavities, and mucous canals may be traversed, or merely entered, while the foreign body lodges. Vital or other important organs may be injured, but it by no means follows that death shall be immediate, in even extensive lesion of some of these parts.

Gun-shot wounds are very liable to be complicated in their progress by various affections. They are peculiarly apt to be followed by deep-seated inflammation, and purulent infiltration of cellular tissue. Necrosis is a very common result of exposure or bruising of bone.

The pain occasioned by a mere flesh-wound from fire-arms is usually not severe at first. There may be a momentary pang, but it is generally more a sense of numbness and loss of power that are experienced. When, however, bones are fractured, and large nerves lacerated, severe pain is at once produced. Hemorrhage may not be great when no large vessel is divided, but when such is the case, bleeding may be copious. It is really as abundant—though perhaps it may not appear externally for some time, as after most other kinds of wounds, except the smooth incision; and certainly much more so than after a simple laceration. The form of a gun-shot, as of a punctured wound, favours the easy suppression for a time of external hemorrhage, even when a large vessel, deep-seated, has been opened; but here, after a period, blood will break out unexpectedly, or it may be pouring forth internally to a fatal extent. Secondary hemorrhage, also, is much to be dreaded, particularly when extensive sloughing, or sloughing phagedæna, occurs—neither of which is very uncommon during unhealthy seasons, and in crowded military hospitals during time of war.

The shock varies much in degree. There seems every reason to believe that the mental part of it, at least, is generally more severe in gun-shot, than in other wounds of equal extent. Owing to the extraordinary force and rapidity of the missiles, against which no guard can be raised, an injury thus inflicted is regarded with a greater degree of apprehension than others of a nature which can, to some extent, be foreseen and guarded against, and which, in a slighter degree, are more generally incurred. I refer to cuts, and stabs, those received in action being aggravated examples of what happens, on a much reduced scale indeed, but still very frequently, to all persons who employ sharp instruments of any sort. Some men certainly sustain very extensive gun-shot injury of the extremities, without being much depressed; or are so only for a short time. But in others, undoubtedly brave, a comparatively slight wound of this nature is productive of the severest symptoms of shock. In this case, however, words of encouragement, together with

the exhibition, if necessary, of diffusible stimuli, soon rouse the patient from this chiefly mental depression. But when the symptoms of shock continue long and severe, notwithstanding the employment of the restoratives just indicated, it may with reason be concluded that there are ample grounds, of a physical character, for its long continuance; and that, owing to the lesion of some important organ, the wound is in reality of a much more serious character than was at first imagined.

In the treatment of gunshot wounds, the first indication is, to promote the departure of collapse when this is present to a serious degree, by encouraging language, and, when necessary, the administration of diffusible, or even more permanent stimuli. The latter, however, should for obvious prospective reasons be, when possible, avoided. If the pain at this early period be excessive, anodyne fomentations are advisable.

When the shock has by these means worn off, the subsequent treatment is to be regulated by a consideration of the nature of the wound—of the part injured, and the extent and kind of lesion—of the present and previous sanatory condition of the patient—and of the means of treatment at command.

Thus, when a limb has been rudely carried away, leaving the remaining parts very much contused and ragged, conditions which would necessarily insure the occurrence of extensive gangrene, great constitutional disturbance, an useless stump, and probably also hectic fever from profuse discharge, and tardy cicatrization;—when there is extensive contusion, amounting almost to disorganization of the soft tissues of a limb, either with or without fracture of bone;—when there is extensive bruising, laceration, or removal of the soft tissues, especially of the chief vessels and nerves;—when there is much comminution, or bad compound fracture of the shafts of bone, particularly of the femur;—when the joint-ends of bones are shattered, and large articulations laid open, such as the knee, ankle, or hip-joint—then, in all these cases, unless there be also some other and decided mortal injury, amputation is generally considered requisite, either actually to save life, or to protect the system from very great risk and suffering, which if at last surmounted, could only result in affording a very bad natural stump, or in the preservation of a useless limb.

In military practice, primary amputation, performed during the few hours between the departure of collapse and the supervening of inflammation and symptomatic fever, has been found far more successful than a similar operation performed at a later period, after the system has suffered from inflammation, irritation, and it may be, typhoid symptoms, extensive gangrene, and probably hectic fever. During the more violent stages of most of these complications, no operation could well be practised, but would require to be further delayed, until the system lapse into a more quiescent state. In campaigns also, it is, in order to save life, frequently necessary to amputate a limb at once, which, with the more ample conveniences for treatment enjoyed in civil practice, might possibly have been saved: but which, owing to the turmoil of the camp, the jolting of the march, the possible deficiency of suitable apparatus, and the crowded condition of military hospitals during war, where the numbers prevent any extraordinary attention from being paid to a single case, would certainly, if not removed, be attended with fatal consequences.

It must be remembered that in the upper extremity, although bones may be badly fractured, or joints opened, with or without shattering of the articular extremities of the bones, yet a useful limb may be saved. In the former case, when there is merely a simple laceration, adhesion may possibly be attained; and in the latter, excision of the joint-ends is preferable to amputation of the limb. The last remark applies also to open fracture of the neck of the thigh-bone, accompanied with bruising, when neither the trochanter nor the pelvis has shared in the comminution.

These injuries, converted by amputation into clean incised wounds, to be healed by adhesion or granulation, being now kept out of view, other cases of a less immediately dangerous character come to be considered.

In addition to promoting departure of collapse, the principal indications are,—to arrest hemorrhage,—to remove foreign matter, whether balls, fragments of metal, clothing, stone, wool, or earth, as well as any portions of bone which have become so detached as to afford no chance of reuniting, but would, if left, become necrosed;—to limit by local and general means the coming inflammation, and its probable sequence, gangrene, which would entail loss of parts and serious constitutional disturbance;—to obviate the accidental complications;—to promote healing, and support the system under suppuration; to remove the limb under certain circumstances by amputation, when extensive or extending gangrene occurs, or suppuration is excessive, and hectic fever otherwise intractable, this being called secondary amputation; and to perform another and second amputation, when the stump obtained by the primary, or secondary operation has been destroyed, or much injured by further gangrene or sloughing phagedæna, with consequent protrusion, and exfoliation of the bone.

The wounds inflicted by fire-arms, which are of an open, lacerated, or contused character, being treated exactly as similar injuries produced in any other manner, the following observations are chiefly directed to those lesions most characteristic of the passage of a comparatively small body into or through the living structures, namely, those wounds which, in addition to contusion and laceration, have a punctured or tubular character.

The first indication, namely, to arrest hemorrhage, may be accomplished by cold, and slight pressure, when there is mere oozing. But whenever an important arterial trunk has been wounded, nothing but ligature of the vessel, above and below the point of lesion, can be trusted to. In order to reach the artery, and permit the application of ligatures, the wound may require to be dilated by incision, perhaps in a very free manner;—a practice which is also necessary under two other conditions, namely, when foreign matter has lodged and cannot be removed without enlargement of its tract, or when matter forms and is not freely discharged. Pressure is usually inefficient to stay the bleeding, and could seldom be applied with the requisite nicety, or without resting injuriously on the neighbouring parts, some of which, as well as a portion of the artery itself, are pretty certain to slough. The second indication,—removal of foreign matter of whatever nature,—may sometimes be effected by the finger or forceps without enlargement of the wound, sometimes by slight dilatation, and occasionally by a mere cuta-

neous incision, when the ball is felt resting beneath the integument. It is very important to remove all extraneous substances, when possible, without great meddling and cutting, because their presence aggravates the coming inflammation, and in this manner retards the cure. But when the foreign matter is deeply lodged among important parts, where dilatation could not be practised without danger, or when it is firmly lodged in or between bones, whence it could not be extracted without further crushing or fracture, it must be allowed to remain until suppuration has ensued. Then the part being relaxed, and the channel widened, it may in general be withdrawn with facility. From some situations, however, bullets cannot be even then removed without very extensive incision. It is sometimes difficult, if not impossible, to ascertain with certainty whether or not foreign matter is present. In some circumstances, indeed, as when it is known that there was only one discharge of a piece of fire-arms, loaded with a single bullet, then the number and situation of the apertures will afford pretty strong presumptive proof of the ball having lodged or escaped, while the part of the body injured, and its distance from the weapon, may indicate whether or not portions of clothing or wadding may also have entered. But, from former remarks, it is evident that in action, where numberless missiles are flying about in all directions, no such inference can be drawn from simple inspection of the wound. Accordingly, the part is placed in the same attitude in which it received the ball, as by the position, the tract of wound, through successive layers of structures, is made more directly continuous, and its exact direction may be more easily guessed. The finger or probe is now to be employed, gently, but with decision, so as to ascertain the presence of foreign matter. Probing is much better tolerated at this early period than on any subsequent occasion. On the extremities, this operation may be performed with some degree of freedom; but when the ball has pierced the parietes, and entered either of the three great cavities, no exploratory proceeding is justifiable. If it be felt imbedded in the substance of the walls, or immediately within them, it should, of course, be removed; but if not at once discovered, no further manipulation is proper. A contrary proceeding might, indeed, at the expense of much injury, satisfy curiosity, yet without in the slightest degree affording opportunity of adopting any important alteration of treatment.

Smooth and rounded balls, when they cannot be removed at first, sometimes remain imbedded for a long series of years, enclosed in a cyst or capsule, seemingly of condensed cellular tissue, or in the dilatation or cul-de-sac of a long, winding, and narrow sinus, so as to be productive of little inconvenience or uneasiness, except during atmospheric changes, much exercise, or general ill-health. In general, they at last come slowly to the surface, when they may be removed, or by creating an unusual amount of discomfort the patient is ultimately induced to submit to a deep operation for their removal. Rough and angular fragments of iron, or of detached bone, create greater mechanical irritation, lead to more active inflammation and suppuration, and require more speedy extrusion. The third indication,—to limit inflammation and its consequences,—is effected locally by rest, elevation, and relaxation of the

part; by careful adjustment; and by cold water-dressing, under the use of which, Mr. Guthrie has shown that the sloughing consequent on gun-shot wounds is much less than under the old treatment by heat and poultice. The cold applications are continued for a considerable time, and when the inflammation has become very high, they are gradually changed for the tepid, and finally for the warm dressing, which by its relaxing effects affords more relief to the parts in their state of tension. Abstraction of blood from the neighbourhood by means of leeches or scarifying, is, in many instances, an important part of local treatment during the inflammatory stage. Generally, the same indication is fulfilled by the antiphlogistic regimen, comprising a moderate unstimulating diet, saline purgatives, and diaphoretics. Purging is, however, to be avoided in any wound as much as possible. When the injured part is disturbed by the motion attending alvine evacuations, venesection may even be necessary; but, as in all wounds which heal chiefly by granulation, depletive measures must be employed with caution.

In a very few instances, where the wound is small and clean, with no lodgment of foreign matter, and a very quiet constitution, it has healed under the above treatment, by adhesion, throughout its whole extent. But it much more generally happens, even when inflammation has been limited to moderate bounds, that a tubular slough is detached from the point of entrance, and a little way beyond it, at which places the contusion has been greatest.

When excessive vascular action ensues, the whole track of the wound may slough, and gangrene extend in any direction.

The remaining indications of treatment are to be fulfilled in accordance with the general principles which regulate practice in lacerated, contused, and punctured wounds. The conditions which require primary, secondary, and second amputation, have already been considered. In the latter two cases, they are in no respect peculiar, or different from the circumstances which, in other injuries, are considered on sound principles to require similar treatment.

POISONED WOUNDS.

Poisoned wounds are those in which the introduction of noxious matter accompanies solution of continuity. The poisonous principle is absorbed by the wound, enters the general circulation, and is rapidly distributed through the body, producing its pernicious effects on the various organs and the vital functions, but manifesting itself in a peculiar degree on the nervous system. On it certain poisons act so rapidly as to have given rise to the suspicion of their having some more direct mode of communication with the cerebro-spinal axis; and this is supposed to be by the nerves of the part with which they have come in contact. The interval between the introduction of the virus, and the manifestation of its peculiar effects, differs in different poisons—varying also in each according to the quantity introduced, and the proximity of the point of entrance to the brain. Some of the more virulent varieties have exhibited their effects in so short a time as the sixth part of a minute; but, generally, the interval is much longer; and some, such as the virus of hydrophobia, may remain in the system for weeks, or even

months, before their characteristic results become apparent. During this period of incubation, as it has been termed, between the introduction of the poison and the manifestation of its effects, it is supposed to become increased in quantity by exciting certain morbid changes in the blood, which, when once commenced, go on multiplying the poison. This process is named *zymosis*, from its supposed analogy to that of fermentation in saccharine liquids on the addition of the yeast-plant. Those poisons, which exhibit their effects very speedily, must, if they operate by a *zymotic* action, accomplish this process with extreme rapidity.

There are, applicable to all poisoned wounds, certain general principles of treatment, the local particulars of which are the most satisfactory in their results. The grand indication is, to prevent absorption of the virus, by immediate excision of the wounded part, by destroying it chemically with an escharotic, or by suction of the mouth, or by an exhausted cupping-glass—a ligature having been applied tightly round the part on the cardiac aspect of the lesion, and retained until either of the above operations has been performed, and until blood has flowed pretty freely from the wound. In some injuries, the gentlest of these means is amply sufficient to prevent bad consequences; but, in others, one or all of them may be found to fail. Subsequent local complications must be treated according to ordinary principles.

These injuries, if at all severe, are generally followed by a stage of depression, which may be so great that the patient rapidly sinks; and in nervous persons, very slight wounds, of a scarcely poisonous nature, are followed by a shock, chiefly of a mental character, produced by the fright more than by the actual injury. During this stage the usual restoratives, of a mental and physical nature, are to be employed. These comprise gentle reassurance, and stimuli when necessary, of which ammonia and brandy are those usually preferred. If the patient live, reaction ensues, violent perhaps, but very generally asthenic. In the slighter forms, sedatives and mild antiphlogistics are to be employed with caution, in order to moderate the excitement of the system generally, and of the local action which, during this stage, is often very severe. At the same time, gentle purgatives and diaphoretics should be exhibited, with the view of promoting elimination from the system. In many instances, however, there is already such prostration of the vital powers, that even in this stage none of the lowering measures can be employed. In some cases, the action is of a more specific character, and its treatment more uncertain; while in others, the patient, after surviving both the previous periods, and after having been much depressed in vital energy by the poison, is brought into great danger by extensive sloughing and diffuse suppuration—conditions demanding, in addition to suitable local treatment, generous support and the judicious employment of all advisable means for maintaining the general strength.

DISSECTION WOUNDS.

Dissection wounds are frequently received without bad consequences, but sometimes they give rise to serious and fatal results. They are

chiefly dangerous when the health of the dissector is impaired from any cause, or when the virus is received from a body in which the cause of death has been puerperal disease, or acute inflammation of serous membranes.

In slight cases, where bad results occur, the wound inflames in a few hours, and a pustule forms, which, on bursting, discharges a thin, unhealthy matter, and is converted into an acute ulcer. [The pustule is often umbilicoid, resembling a small-pox pustule. When opened in the early stage, serum escapes, which is nearly transparent, and the yellow appearance of the pustule still remains, showing that its colour does not depend always upon pus, but upon a fibrinous exudation. In a short time the vesicle becomes larger, and is refilled with serum, which, as the inflammation advances, will be found to contain pus. Should it heal by scabbing, the scab will be very thick, and composed in a great measure of cuticle, and will be very slow in dropping off.—ED.] In more severe cases, erythema, erysipelas, whitlow, or inflammation of the lymphatics of the arm, may occur; or chronic abscess with induration, or acute abscess with purulent infiltration, may form in the axilla; and this last complication frequently extends down the corresponding side of the thorax. In very severe cases, the axillary symptoms, commencing with acute pain and rapid formation of abscess, may occur before much irritation about the wound is perceived. The constitutional symptoms vary in intensity. In slight cases the constitutional affection may be sthenic and trivial, but in more severe instances, the asthenic, irritative, or even typhoid type prevails. In the worst instances, the systemic disorder appears before the occurrence of any very distinct local signs of inflammation.

The treatment of the wound varies according to its form and the subject from which the virus has been introduced

If the body be that of a person who has died of acute peritoneal or puerperal disease, it is advisable, after washing, to make a perfect excision of the wounded part; to allow oozing to go on for a short period, and if any time has been allowed to elapse between the infliction of the wound and the performance of excision, in addition to the above proceedings, to employ suction; and after oozing has ceased, to touch the part very freely with the nitrate of silver, with the view of effecting destruction of any virus that may be lurking in it. In any ordinary case, it will be considered sufficient to wash the part instantly, to suck it well, and if it be a mere puncture, and do not bleed, to enlarge the opening slightly with a clean pointed knife, so as to encourage the flow of blood, and thus favour the removal of any matter. The nitrate of silver is frequently employed as an escharotic after suction, without excision, and is probably useful by destroying or neutralizing the virus, if present, and by forming a crust of coagulated effusion, which prevents admission of noxious matter. I should never, in any case of poisoned wound, trust to an escharotic alone; and it ought to be remembered that, if the nitrate of silver be used gently, it acts merely as an astringent, and that it is only when it is used very energetically, that it has an escharotic effect. It is advisable for some time to preserve the part at rest, in an elevated position, and to enclose it for a few hours in a soft soothing poultice.

[In the treatment of pustules arising from dissecting wounds, I have found it very serviceable to apply the nitrate of silver freely to the inflamed surface contiguous to the pustule, and to enclose the limb in a large cold poultice of Indian meal. The burning sensation experienced in dissecting wounds is increased by hot adhesive poultices, such as those made of ground flaxseed, but the Indian meal, being less glutinous, allows evaporation to take place whilst the skin is still kept moist.—ED.] The digestive organs should be cleared out, the diet attended to, and all sources of local and constitutional irritation avoided. If constitutional or local symptoms supervene, they should be treated according to the principles already mentioned.

MALIGNANT PUSTULE.

Butchers and others who have to do with the bodies of the inferior animals, occasionally meet with wounds of a similar character, and requiring the same treatment as those to which the medical student in the anatomical rooms is liable. But there is one variety of wound thus obtained, which is somewhat peculiar in its consequences. The affection is characterized by the formation of a dark vesicle, rapidly followed by very painful inflammation and hardening of the dermis immediately below and around it. The vesicle bursts, the cellular tissue becomes involved, and sloughing phagedænic ulcer is produced. The constitutional disorder may at first be sthenic, but it very soon becomes typhoid, and as the local destruction extends, life is brought into the greatest danger. The constitutional and local treatment for malignant pustule is the same as that resorted to in the worst forms of sloughing phagedæna, attended with great constitutional depression.

WOUNDS INFLICTED BY THE BITE OF A DOG.

Wounds inflicted by the bite of a dog are always regarded with apprehension, because, although the animal seem healthy at the time, and may not become evidently rabid for several weeks after, yet a person, bitten during the stage of incubation in the animal, is liable to be attacked with the fatal disease, Hydrophobia. Many more persons, however, are bitten than are so attacked, even when the dog is manifestly affected. When the wound is inflicted through a portion of clothing, there seems to be less danger, probably owing to the teeth having been wiped clean in their passage through the dress. The virus contained in the saliva of the animal, whether dog, wolf, fox, cat, or badger,—for all these may become rabid,—must, as far as the integument is concerned, be applied to an abraded surface or wound, ere it can produce the disease. But several very striking cases, recorded by the late Mr. Youatt, seem to warrant the conclusion at which he arrived, namely, that mere contact with the mucous membranes may, without abrasion or breach of surface, communicate the disorder.

The local treatment of a bite from a dog varies according as it is believed that the animal is healthy or not. If there seems every reason to conclude that the animal is perfectly well, not being even in the stage of incubation, and that the bite, consequently, was merely inflicted after provocation, or in self-defence, then the part should be well washed, a

cupping glass applied to withdraw any simply irritating matter, and the wound afterwards treated for granulation, like any other puncture or laceration. But if there be the slightest grounds for suspecting that the animal is rabid, or in the stage of incubation, instant and complete excision of the bitten parts is the only practice which can be trusted; and, till this is accomplished, a ligature should be bound tightly around the limb between the point of lesion and the heart, so as to prevent venous return and absorption. An exhausted cupping glass is then to be applied, which will abstract any virus that may have penetrated more deeply, at the same time that it draws blood. The raw surface is finally to be treated with lunar caustic, which will arrest any persistent oozing, and, if possible, make security doubly sure, as regards the destruction of noxious matter. The nitrate of silver is sometimes employed alone, by persons of great experience, in preference to excision. Amputation even is requisite, if the part, such as a finger or hand, is so much lacerated and bruised that complete excision cannot well be effected. Though a period of several days may have elapsed after the bite, still, until the commencement of the local sensations which precede that of hydrophobic symptoms, the operation of excision or amputation should be performed. Subsequently, the tone of the general health is to be maintained, and mental anxiety as much as possible calmed. Dr. Watson, in his admirable work on "The Principles and Practice of Physic," has so clearly stated what ought to be the proceedings of the surgeon regarding these wounds, that I cannot avoid transcribing his observations. "In the matter of cure, surgery, I fear, is as impotent as physic. Not so, however, in the matter of prevention: this is the most important part of the practice. The early and complete excision of the bitten part is the only measure in which we can put any confidence: and even here we are met with a source of fallacy. In the majority of cases, no hydrophobia would ensue, though nothing at all were done to the wound. How can we know, then, that the disease is ever prevented by its excision? No doubt many persons go through the pain of the operation needlessly. But in no given case can we be sure of this. They get at any rate relief from the most harassing suspense, with which they would probably have been tortured for months. And if a large number of bitten persons, who have suffered the wound to heal as it would, could be compared with an equal number who had had the bitten part cut out, hydrophobia would be found a frequent consequence of the bite in the first class,—a very rare consequence of it in the second.

"Mr. Youatt, who trusted to caustic, and who had himself been bitten seven times, tells us that he had operated, with the caustic, on more than four hundred persons, all bitten by dogs, respecting the nature of whose disease there could be no question, and that he had not lost a case. One man died of fright, but not one of hydrophobia. Moreover, a surgeon of St. George's Hospital told him that ten times that number had undergone the operation of excision there, after being bitten by dogs (all of which might not, however, have been rabid), and that it was not known that any one had been lost. Mr. Youatt, I say, trusted to caustic, and the caustic he used was the nitrate of silver. But I

advise you to trust to nothing but the knife, if the situation of the bite will allow you to employ it effectually. If the injury be so deep, or extensive, or so situated, that you cannot remove the whole surface of the wound, cut away what you can; then wash the wound thoroughly, and for some hours together, by means of a stream of warm water, which may be poured from a tea-kettle, place an exhausted cupping-glass from time to time over the exposed wound; and, finally, apply to every point of it a pencil of lunar caustic. If you cannot bring the solid caustic in contact with every part, you had better make use of some liquid escharotic—the nitric acid, for example. In my own case—and what I should choose for myself I should advise for another—if I had received a bite from a decidedly rabid animal upon my arm or leg, and the bite was of such a kind that the whole wound could not be excised, my reason would teach me to desire, and I hope I should have fortitude to endure, amputation of the limb, above the place of the injury.

I say *early* excision is the only sure preventive; but let me repeat that it will, in all suspicious cases be advisable (if, for any reason, the operation have been omitted in the first instance) to cut out the wound, or the cicatrix, within the first two months, or at any time before the symptoms of recrudescence have appeared. One would do it, though with less hope, as soon as possible *after* they had appeared; but I do not expect to hear of excision being successful then in stopping the disease. Dr. Bright has recorded a case in which the arm was amputated upon the supervention of tingling and other symptoms in the hand, in which the patient had been bitten some time before; but the amputation did not save him."

THE STINGS OF INSECTS.

The stings of insects are rarely dangerous in this country, unless when very numerous, when inflicted on delicate parts, or on persons of an irritable constitution. If the sting be discovered by aid of a lens, it should be withdrawn by the point of a needle or fine forceps. Then, if it be a single puncture, mere suction for a considerable time will afford perfect relief; or the minute wound may be supplied with a drop of liquor potassæ, which is supposed to neutralize or destroy the irritating matter. But this remedy must be applied to the exact spot alone, as, when undiluted, it exercises a powerful solvent effect upon the skin. Cold is then kept continuously applied by pure water or a saturnine lotion. When the stings are numerous, or the individual nervous, considerable depression may ensue, from the actual effects of the injury in the one case, or from mere fright in the other. Restoratives and stimuli may therefore be necessary; and when reaction occurs, attended by nervous excitement and irritability, sedatives and mild antiphlogistics are indicated. When an insect gains entrance to the nostril, mouth, or fauces, its sting is particularly distressing, and, in the last-named case, even dangerous, owing to the great and rapid tumefaction of the mucous membrane, and consequent interference with respiration, demanding instant relief by local scarification, followed by fomentation, and counter-irritation externally.

EQUINA.

Equina—a disease so named because animals of the equine genus, as, the horse, ass, and mule, are subject to it—is sometimes transmitted to man by inoculation, or contact, and sometimes also, it is said, by infection. In the former case, the local consequences, up to a certain stage, are the same as in the more severe forms of dissection wounds. In both, there is fever of an asthenic type. The disease is afterwards characterized by severe pains in the joints and limbs, followed by hard, circumscribed swellings beneath the integument of these parts, which then ulcerates or sloughs; by a sanious purulent discharge from the nostrils, but which, however, is not uniformly present; by the formation of numerous characteristic pustules, which generally become gangrenous; by a very low typhoid fever; and by speedy death, which usually occurs about the end of the first fortnight. The pustular eruption is considered most characteristic of this disease, which is commonly called “Glanders,” when this symptom is present along with the affection of the nasal passages, and “Farcy,” when these peculiarities are absent.

Hitherto the disease has been almost uniformly fatal, and the treatment adopted is merely palliative. The indications are, to support the system, and to alleviate local symptoms by fomentations, and deodorising lotions. Of the former, a solution of creasote; and of the latter the chlorides dissolved in water are the most efficient.

THE BITES OF SERPENTS.

The bites of serpents lead to results varying according to the species which inflicts them. The common viper is the most dangerous that is found in this country, but its bite is very seldom fatal. The effects are often distressing, but are scarcely dangerous, except in children, and in delicate persons of great susceptibility. The local irritation is repressed by the continuous application of cold, or subsequently soothed by heat and moisture, if it proceed to actual inflammation. In this case moderate antiphlogistics may be required. Any other consequences, similar to those which result from dissection wounds, are treated on similar principles.

“Of the numerous American serpents two species only are known to be venomous—the *rattlesnake* and *copperhead*. Eight varieties of the former have been familiar to naturalists, and two others have been discovered lately by Humboldt¹ and Bonpland. All are poisonous, but in particular the *crotalus durissus*, *horridus*, and *miliaris*. The copperhead (*boa crotaloides*) sometimes called the bastard rattlesnake, is also exceedingly malignant. All these reptiles are furnished with long teeth, or poisonous fangs, the roots of which are surrounded by a bag or reservoir containing an active or virulent poison. This poison is discharged into the wound through a small fissure of the tooth situated near its extremity, and in many instances very quickly proves fatal both to man and to inferior animals. As regards the effect of the poison,

¹ These are the *Crotalus Cumanensis* and the *Crotalus Lefingii*. See *Recueil d'Observations de Zoologie et Anatomie Comparée*, 4to.

much will depend upon the size of the animal bitten—death being produced more readily in the smaller than in the larger animals. According to the experiments of Vosmaer, sparrows, finches and other small birds died in about four minutes, while a mouse died in a minute and a half. The deleterious operation of the poison will also depend materially upon its quantity, and upon the season of the year at which the wound is inflicted. To ascertain the effect of the bite of the rattlesnake, several experiments were made by Captain Hall, of Carolina, upon dogs, cats, chickens, and frogs. Three dogs were bitten in succession by a snake four feet long. The first died in less than a quarter of a minute, the second in two hours, and the third in three hours. Four days after two other dogs were bitten; one of which died in half a minute, the other in four minutes. Several experiments, nearly similar, were made by the late Professor Barton on chickens. Of three chickens bitten on three days successively, one died in a few hours, another lived much longer, and the third recovered, after having been exceedingly swelled. On the fourth day, several other chickens were bitten, but recovered without a bad symptom.

“The rattlesnake is more lively, and its venom more active, during very warm weather than at any other period: upon the approach of cold seasons it becomes languid, and then strikes reluctantly, and frequently without any ill consequence. The effects produced by the poison either on the human body or on the lower animals, vary according to the parts wounded, the depth to which the fang penetrates, and the quantity and strength of the venom in the reservoir. In many instances death follows in a few seconds or minutes, and in others not until many days or weeks. The interesting case detailed by Sir Everard Home, which I witnessed whilst a student in London, furnishes striking proof of the speedy operation of the poison of the rattlesnake, and at the same time affords incontestable evidence that it may remain a long time in the system before death is produced. The patient was teasing a large rattlesnake with the end of a foot rule, but could not induce the animal to strike; the rule accidentally dropped from his hand, he opened the door of the cage to take it out; the snake immediately darted at the hand, and inflicted four wounds—two on the back part of the first phalanx of the thumb, and two on the side of the second joint of the forefinger. The hand soon after began to swell, and in the course of ten or eleven hours the whole arm, axilla and shoulder were very much tumefied, and cold. There was an unusual coldness also throughout the skin of the whole body. At this period, the mind of the patient was perfectly collected; but immediately after the accident he talked incoherently, owing probably to strong drink, which it was ascertained he had taken before he was bitten. From the axilla the swelling extended down the side, and blood was extravasated under the skin as far as the loins, giving the back a mottled appearance. The skin over the whole body became warm, faintings occurred repeatedly, vesications appeared in different parts of the body, a large abscess formed on the outside of the elbow, and discharged half a pint of reddish matter; mortification took place in the axilla, in the forefinger, and some other parts, and finally destroyed the patient, after he had laboured for

eighteen days under the most distressing symptoms. Upon dissection, the body presented a natural appearance (with the exception of the arm that had been bitten), and the wounds made by the fangs of the reptile had healed.

"Instances have occurred, both among the Indians and among the white people, who inhabit the mountainous and thinly-settled parts of our country, of almost instantaneous death from the bite of the rattlesnake. On the other hand, it is very certain that many persons wounded by this animal have sustained very trivial injury, if any. In such cases, it is probable that the teeth enter obliquely, and do not penetrate the true skin, or that the reservoirs at the roots of the fangs have been empty, or the virus itself, owing to particular circumstances, so modified or changed in its properties or in such small quantity as not to produce fatal effects. Again,—where death has followed almost immediately or shortly after the wound, the poisonous fangs have probably penetrated directly an absorbent artery or vein, and conveyed the noxious matter at once into the circulation. According to Catesby, the Indians very soon ascertain when this has happened, and under an impression that the wound is necessarily fatal, apply no remedy. Upon these principles it will be easy to account for the supposed good effects of the numerous and diversified remedies at different times proposed for the cure of the rattlesnake; inasmuch as there is reason to believe that nature, unassisted, is often sufficient to accomplish a cure, or that a sufficient quantity of virus has not been inserted to produce death.

"The poison of the rattlesnake is of a yellow colour tinged with green: during extreme heat, and particularly in the procreating season, it becomes of a much darker hue. The *copperhead* is equally poisonous with the rattlesnake; but few experiments have been made to ascertain its peculiar character."¹

["But the best plan of all, is that recommended by Sir David Barry. He directs, first, that an exhausted cupping-glass shall be applied over the wound, for a few minutes; next, the glass is to be taken off, and the wound freely excised; and lastly, the glass is to be applied again, in order to promote the flow of blood, and cause the re-exudation of any of the poison, that may have found its way into the neighbouring blood-vessels. The cupping-glass, used in the manner we have just detailed, possesses all the efficacy and none of the disadvantages of ligatures; for, without interrupting the general circulation of the limb, it produces a complete afflux of all the fluids in the vicinity towards the wounded part, and entirely prevents them from conveying their contaminated contents towards the centre of the circulation. If the glass is applied in this manner, it is far from being advantageous (as is generally supposed), to make incisions or scarifications near the wound, whether before or after its excision; for the object is to concentrate the course of the blood towards the original wound itself, so that it may carry the venom with it, as it escapes; and this object would be counteracted by any extraneous incisions.

"The *treatment of snake-bites* during the first stage, consists first, in

¹ Gibson's Surgery, vol. i., pp. 79-81.

the administration of powerful diffusive stimulants, such as hot brandy and water, ammonia, or the *eau de luce*, to support the nervous system; and secondly, in the use of remedies which may be supposed to eliminate the poison from the blood. Thus, if there is no vomiting, it should be excited by a mustard emetic, to get rid of the vast quantity of bile that is often formed in the blood, and secreted by the liver under these circumstances; if, however, vomiting is spontaneous, and too violent, it should be checked by a large dose of solid opium, and a mustard poultice to the epigastrium. But the principal remedy seems to be *arsenic*, which has long been popular for these accidents, in the East Indies. It is usually administered there in the form of a nostrum, called the Tangore pills, each of which contains a grain of it, combined with certain unknown acrid plants. The efficacy of this mineral was also fully established in the West Indies, by Mr. Ireland, surgeon to the 16th regiment, who employed it with perfect success, in five cases of the bite of a serpent, which had previously killed several officers and men, some within six hours, and all within twelve. He combined f3ij of the *liquor arsenicalis* with gtt. x. of tinct. opii (to prevent vomiting), f3iss of peppermint water, and f3ss of lime juice. This draught, which contains a grain of the arsenious acid, was given every half hour, for six or eight doses, till it produced copious purging (which was encouraged by clysters), or till the symptoms were ameliorated. The swelled parts were well rubbed with a liniment of olive oil, turpentine, and liquor ammonia;—and the patients, although for a time greatly debilitated, were soon able to return to their duty.”

“If the local symptoms are very slight, stimulating embrocations, and hot fomentations, with leeches, may be sufficient. But if the swelling is rapid and extensive, or the constitution is much affected by the poison, free and extensive incisions into the swelled parts are indispensable.

“The *constitutional treatment* of the second stage must be regulated by the symptoms actually present; it will most likely require a combination of cordials, opiates, and tonics.”¹

¹ Druitt's Surgery.

CHAPTER IV.

BURNS.

A BURN is an injury inflicted on the body by a degree of heat higher than is compatible with healthy action in the part affected. Burns are produced either by actual contact with flame or heated bodies, or by radiation of caloric from them; and their severity depends on the proximity and intensity of heat, the length of time it has been applied, and the nature of the heating agent, as also that of the injured part. Thus, flame, which can exist only at a very high temperature, and which speedily induces combustion of the tissues; steam, whose latent heat becomes sensible on condensing; metals whose density and conducting power are great; and oil, which maintains a high boiling point, and adheres to the skin;—all produce severe burns, which, *ceteris paribus*, are most severe on those parts where the epidermis is thin and delicate. This condition, when produced by heated liquids or vapours, is usually styled a *scald*, the term burn being then restricted to those cases where a dry body has been the agent of injury. As the heat of solid bodies is frequently much greater than that attained by fluid substances, except metals in a state of fusion, the former may produce very deep burns; while liquids, by flowing over a large surface, cause more extensive, though comparatively superficial lesions.

The Classification now generally employed, as being the most scientific and convenient, is that of Dupuytren, who arranged all burns into *six classes* or *degrees*; the tissues involved, and the amount of lesion being made the basis of classification. The *first* degree consists of a superficial inflammation of the integuments, *unattended* by vesication. The *second*, in addition to the rubefaction, is accompanied by vesicles. The *third* exhibits the skin partially disorganized, the cuticle, together with the papillary surface of the cutis, being destroyed and converted into a thin eschar. In the *fourth* degree, the whole thickness of the skin, including, sometimes, the subcutaneous cellular tissue, is carbonised. The *fifth* degree only differs from the preceding in penetrating more deeply; an eschar being formed which comprehends the several soft tissues beneath the integument, down to a variable depth, perhaps even to the bone itself. In the last or *sixth* degree, the whole thickness of the limb or part is carbonised.

Consequences of Burns.—If at all severe or extensive, this kind of injury is liable to be followed by many serious consequences, which, though generally more or less combined in practice, may, for better description, be divided into two orders—namely, Local and General; or, into Inconveniences and Dangers; the former being hostile to the pre-

servation of the comfort or limbs of the patient—the latter being dangerous to life itself. By a due knowledge and consideration of these, the treatment and prognosis must in every case be regulated. The first order, which consists of those *local* effects not directly dangerous to life, consists, with a single exception, of various conditions attending cicatrization, and productive of functional lesions, partial or complete. They have been enumerated under the heads of adhesions, deformities, and mutilations; to which may be added disfigurements, and affections of the cicatrix. The *disfigurements* consist of those unseemly cicatrices, especially on the face, neck, and other exposed parts, which merely affect the appearance rather than entail any serious discomfort. They are produced principally by burns of the third degree, by slight cases of the fourth, and sometimes also by severe instances of the second, when the epidermis forming the vesicles has been torn off, exposing the cutis to the stimulus of the atmosphere, to irritation and subsequent suppuration. The *adhesions* imply those conditions in which, during cicatrization, contiguous tissues or surfaces, which in their natural state move freely on each other, have become mutually adherent, thereby abridging voluntary motion, as when a cicatrix adheres firmly to a muscle, tendon, or aponeurosis beneath; or these latter to one another. *Deformities* are constituted by any considerable alteration in the shape of an organ, or in the relation which one part naturally bears to another. They may be produced in two ways; either by contraction of the cicatrix, or by destruction of muscular antagonism. The cicatrix following a burn is said to have a greater tendency to contract, than after any other species of injury. Like all new, and lowly-organized structures, it is very liable to absorption, which makes the contraction and puckering of the tissues around go on long after the sore has healed. Wherever a portion of skin has been destroyed in this manner, as in a burn of the fourth degree, its place is eventually supplied, not altogether by a new and permanent structure, but to a very considerable extent by the uninjured integument in the neighbourhood, which, by the steady drag exercised on it by the gradual contraction of the cicatrizing ulcer, or the cicatrix, is drawn together towards a central part, which is at last occupied by the cicatrix, now much diminished in size, shrivelled, and sometimes almost of a horny texture. The surrounding integument stretches to a certain extent, more especially in those parts where it is loosely connected with the tissues below: but if the loss has been very extensive, the requisition on the integument around will be proportionately large, and this demand may prove more than its extensile qualities can supply. Accordingly, if a burn be so situated, that flexion or other posture of a neighbouring articulation will relax the skin around the seat of injury, the steady drag on the integuments, added to the natural tendency of the limbs to preserve a slightly flexed position, will produce, if not guarded against, a permanent flexure of the joint. The same remarks apply with still more force, when the deeper-seated parts have, as well as the skin, been destroyed. Thus the fore-arm has been immovably bent on the arm, the latter bound to the side, the lower jaw dragged down to the sternum, and the head drawn back between the shoulders. When the injury is

situated on the extensor aspect of an extremity, the tendency, above mentioned, of the limbs to sustain a slightly bent position, is in general sufficient to counteract the extending force of the contracting cicatrix. This is not, however, always the case, for the fingers have frequently been bent backwards upon the metacarpus, and the foot has been so twisted and deformed that all trace of its original conformation has been destroyed. Deformities from this cause, and to this extent, are now, however, much less frequently met with than formerly; though, in injuries of such a nature, the motions of the joint almost always remain more stiff and constrained than natural, and are farther restricted by the abnormal adhesions formed between the cicatrix and the subjacent parts. Again, in those cases where the tissues beneath the integument are destroyed, as in a burn of the fifth degree, in which the continuity of muscles, tendons, or aponeuroses has been interrupted, the contractions of the cicatrix, together with the unnatural adhesions, frequently cause deformity, fixation, and even dislocation of a neighbouring joint. As in other injuries, when the solution of continuity affects a nerve, loss of voluntary motion or of sensation must ensue in the parts supplied by it on the peripheral side of the injury, by which occurrence the antagonism of two sets of muscles may be destroyed, and deformity produced. *Mutilations* consist in the partial or complete loss of an organ. They are immediate in all burns of the sixth degree, and in those of the fifth, in which the possibility of saving a useful limb is at once rendered hopeless. They are consecutive, when caused subsequently either by the violence of inflammatory reaction inducing extensive gangrene, or where the limb, as it remains, is so utterly useless as to necessitate amputation; an operation which is also sometimes necessary to save life when it is endangered by hectic from the exhausting effects of profuse and prolonged suppuration. The *affections of the cicatrix* are chiefly excessive contraction, fissure, ulceration, and irritability. As it is less highly organized than the original integument, it is peculiarly liable to the first three of these conditions, in conformity to the general law, that newly-formed and lowly-organized structures are much more prone to absorption, to inflammation, and other diseases, than older and more highly constituted tissues. Irritability of the cicatrix may be the result of a nervous filament or trunk being implicated in it, as occasionally happens after an ordinary amputation; or it may occur without any such apparent cause.

The second order of consequences, comprising the *general* or constitutional effects, are those which more immediately endanger life. They may be arranged, chiefly according to the periods at which they occur, into six groups. First,—when a large extent of surface is burnt though but superficially, and more particularly when to the third degree, a shock is communicated to the nervous system, either by intense pain excited in the wide expanse of integumentary nervous web which is injured, or by the sudden destruction of the functions of the integument. It is believed that this shock occasionally causes instantaneous death by *asthenia*, or the *asthenic* form of syncope—the heart ceasing to act from its irritability or contractile power being annihilated. The same result may take place when the burn, though of less extent, has penetrated

more deeply and injured some vital or important organ; but, with this exception, it is a well-ascertained fact that burns are more dangerous from their extent than from their depth. Second,—more frequently it happens that death is *not* immediate. There is great depression and collapse of the vital powers, which gradually sink in a few hours. The immediate cause of the fatal issue in this instance may be, as in the former, asthenic syncope, with this difference, that here the functions of the heart are slowly and gradually suspended, instead of being instantly arrested. Females, children, and persons of a nervous and irritable temperament, are most liable to sink in this manner. In other cases, death is preceded by typhoid symptoms, low muttering delirium, and coma. When the functions of a large portion of integument are suddenly suspended, the healthy balance between them and those of the lungs is destroyed; the latter become, with the other internal organs, greatly congested, and soon cease to effect proper aeration of the blood. This leads to more retarded circulation in the pulmonary system; the brain is supplied with imperfectly purified blood; coma ensues, which still further retards the flow of blood through the lungs; and death results at last, from apnoea, accelerated by coma. Third,—In other cases, the collapse goes off, and is succeeded by an imperfect and feeble reaction, attended with great irritability and excitement of the nervous system, under which the patient may sink exhausted. Constitutional debility and irritability predispose to this termination. Occasionally, death has occurred about this period from tetanus, or from convulsions. Fourth,—On the disappearance of collapse, vigorous reaction may ensue. When this is confined within proper limits, it is the first step towards recovery; but when excessive, and accompanied by very high symptomatic or inflammatory fever, it is equally perilous to life, as would be its deficiency. Sometimes, accordingly, the patient dies during the stage of excessive reaction. At this period, also, congestion and inflammation are very apt to occur in the mucous membranes, and several internal organs, more especially the lungs, the intestines, and the brain. These serious complications render the prognosis much more unfavourable, and frequently prove the chief causes of death. The upper portion of the duodenum is the part of the intestinal canal which is most frequently affected. Sometimes the inflammation here leads to ulceration, especially in young persons; and, occasionally, during the ulceration, a small artery is opened, hemorrhage ensues, and the patient generally dies, either from a single profuse loss of blood, or from a more sparing discharge, frequently repeated. Death in this instance takes place by that form of syncope in which the heart primarily ceases to act, from the want of a sufficient volume of blood to excite its contractions; the nervous system being consecutively affected by the deficiency of the nutrient fluid. This mode of death is accordingly called, by Dr. Watson, *anæmia*. Of hemorrhage from the above cause, about a dozen cases are on record. Gangrene, from excessive inflammatory reaction, may prove fatal by a combination of asthenic syncope and coma. Any of the serous membranes, or the organs which they invest, may, in like manner, be attacked by inflammation. As a general rule, those internal parts are most apt to suffer, which are nearest to the external lesion.

Apoplexy occasionally occurs from the fifth to the seventh day. Dupuytren considered this to be owing to idiosyncrasy, but it is more simply explained by referring it to vascular excitement in a person, the arteries of whose brain are already in a state of disease. Confirmed drunkards have been attacked, about this period, with delirium tremens; and in pregnant females, the premature expulsion of the fœtus is said to have occurred. Fifth,—During, and after the detachment of sloughs, new dangers arise. In bad constitutions, or where the powers of life are much enfeebled, the separation of the eschar by ulcerative absorption may not have been preceded by a sufficient effusion of plastic lymph on the layer of living tissue next to the dead mass; accordingly, if any considerable artery, or even vein, has been involved in the slough, dangerous or fatal hemorrhage may take place from its open mouth, which has not been sealed up, as, under a more favourable state of the system, it would have been. The same result may ensue from an artery being denuded at this period, and afterwards ulcerating. The possibility of such an occurrence suggests the propriety of using *no* force in removing the sloughs, lest the blood-vessels be not yet prepared for the separation. When the eschar has been very extensive, persons have occasionally died soon after its separation without any very obvious cause, unless it has been owing to the sudden exposure of a large ulcerating surface to the irritation of the atmosphere, inflicting a second shock on the system, which, though it was able to withstand the primary effect of the injury, succumbs to this second attack in its now enfeebled state. If this be the true explanation, then the raw surface, when of large extent, should be exposed only partially, as seldom as possible, and for as short a time as practicable, at each dressing. During suppuration, phlebitis and pyæmia have sometimes occurred, and destroyed life with the most urgent typhoid symptoms. After all the preceding dangers are past, if the process of cicatrization, over a large surface, be tedious, and suppuration very profuse, the exhausting effects of this drain on the system, combined with long confinement, tend to induce hectic fever, under which the patient may sink. The fatal issue is sometimes much accelerated by the development and rapid progress of phthisis pulmonalis. A more common adjunct of the hectic, is colliquative diarrhœa, from irritation and ulceration of the intestinal mucous membrane, particularly in the vicinity of Peyer's glands on the lower part of the ileum. Sixth,—Even the period of cicatrization, according to Dupuytren, is not exempt from danger; for he mentions that when this process has been nearly or entirely completed, persons have sometimes died suddenly and in a manner unaccounted for, even on dissection. This singular occurrence may be supposed to be connected with the suppression of the purulent discharge, which, though not natural, yet from its long continuance before cicatrization was effected, had become a habit—and, in fact, necessary, in some degree, to the constitution.

Post-mortem Appearances.—The local effects of burns have already been sufficiently described to enable any one to understand what conditions may be expected on examination of the parts with the scalpel, when opportunity offers for so doing. In persons who have died immediately, or shortly after extensive burns, from the primary shock,

Dupuytren says, the intestinal mucous membrane presents, in many places, bright red patches of variable size, and other marks of great congestion,—the fluids of this canal, especially in the stomach, being deeply tinged with blood. Other observers, however, have not found the preponderance of congestion in the mucous membranes to be so great, or so constant, as Dupuytren in such cases has represented it. The cerebral sinuses are gorged with blood; the brain and its membranes very much injected, its ventricles filled with a pinkish serum; and a similar fluid is found within the peritoneum, pleura, and pericardium,—these being in some parts dotted, or streaked with red points and lines of vascular injection. When the patient dies during reaction, many of the above-mentioned appearances will be present. The symptoms during life will assist in pointing out which organ, if any, will be found the principal seat of inflammation or of congestion.

The *prognosis* of burns, except of those which are very trifling, is always uncertain in the early stages; not only from the possibility of any of the preceding fatal terminations occurring; but also from the circumstance that it is frequently impossible, till an advanced period, to predicate the amount of lesion. In some instances it is doubtful at first how far the destruction has extended; and in others the immediate injury is followed by a secondary sloughing of the tissues, consequent on the violent inflammatory reaction in these parts, the vital powers of which were considerably lowered, though not entirely destroyed at the moment when the injury was inflicted. In forming a prognosis, we must be influenced by a consideration of these points, and of the sex, age, constitution, previous habits, and present sanatory condition of the patient; as also of the extent of the burn in superficial area, and in depth;—of its relative situation, and the nature of the part. Females, children, and persons of a weak, nervous, and irritable temperament, are, as might be expected, more liable to the dangers attendant on this kind of injury than males, adults, and those of a stronger, and less excitable constitution. Old age again, which by its accompanying debility is exposed to the dangers of the former class, and is little able to survive the shock, or to support the tedious suppuration, is, however, less liable to those congestive and inflammatory attacks which so often complicate the injury in younger and more full-blooded individuals. Previous pernicious habits, present disease, or any circumstance which tends to weaken the general health, increase the danger. Intemperance in alcoholic liquors, is a strong predisponent to a fatal issue in this, as in other serious injuries. These various conditions do not all agree in producing danger in the same manner. Thus a weak and nervous individual, be the weakness from whatever cause, whether from the extremes of age, from disease, or from previous irregularities, is peculiarly liable to sink under the primary shock. To a strong plethoric adult the period of reaction, with its internal congestions, and it may be inflammations, is the most dangerous. Asthenic persons again, if they have survived the preceding stages, are, especially when of the strumous diathesis, prone to succumb during the period of suppuration and hectic. It was before stated that the danger of a burn is more proportioned to its extent of surface than to its depth, except when in the latter case vital or im-

portant organs have suffered. The depth, on the other hand, more than the superficial area, regulates the amount and nature of the local sequelæ. The influence of relative situation is shown by a burn, which in one place would be comparatively unimportant, producing, in another site, very serious consequences.

With regard to the local results, it may be considered a general rule, that, other things being equal, a burn will produce an amount of deformity directly proportional to the freedom of action naturally enjoyed by the part which is the seat of injury. Thus, when in the neighbourhood of a joint, its fixation;—when near the mouth, hideous distortion; close to the eyelids, their eversion, ectropium, adhesion of their margins to one another—are conditions easily induced. The influence of relative situation in causing danger, is exhibited by otherwise insignificant burns of the scalp, exciting inflammation in the brain or its membranes; of the thorax and abdomen, in inducing the same morbid action in the serous linings of these cavities, and in the latter situation, when deep, predisposing to hernia or protrusion of some of the viscera, from weakening of the abdominal parietes.

Again, when situated near the orifices of mucous canals, the transit through them may be materially interfered with, whilst their natural secretions, coming in contact with the sore, may deteriorate its action, and retard its healing. Thus in a scald of the mouth, fauces, and pharynx, from an attempt to swallow a boiling fluid, dysphagia or difficulty of deglutition will ensue, which, if the injury be severe, may not pass off with the inflammation, but may continue permanently, through contraction or stricture of the upper part of the œsophagus. But there is here a more immediate source of danger: the scalding liquid may penetrate into the larynx as far as the glottis, and excite acute inflammation of it and the epiglottis; or the same result may take place by propagation of the action from the pharynx, without the fluid passing below the epiglottis into the larynx at all. This condition will produce dyspnoea, or even death by apnoea if not relieved. In these instances it is believed that the liquid does not pass into the œsophagus, or farther down the larynx than the rima glottidis; the spasmodic muscular action, in both these parts, effecting closure of their respective canals. Occlusion of the puncta lachrymalia may ensue from a burn in their neighbourhood. Dysuria results when the genitals are implicated; and, in the female, the contact of the acrid urine may aggravate the injury. When close to the anus the pain experienced during defecation induces the patient to perform this as seldom as possible, and constipation is the natural sequence. The situations, then, on which burns are most dangerous, are the head and neck; the genitals, particularly in children; and the trunk generally. When on the hands and feet, tetanus has followed this, as well as other injuries of the same parts.

It has been stated that a fatal result will almost certainly take place from a burn of the first or second degree, which involves half of the entire surface of the body; from one of the third grade, affecting a quarter; and from those of the fourth, fifth, and sixth degrees, in which the eschar comprehends more than a square foot. No doubt, these points will frequently be found to be correct; but from what has been

said above, it will be evident that under particular, though by no means unusual, circumstances, a very much smaller amount of injury may lead to death.

The *First Degree* is most commonly caused by contact with heated liquids or vapours, or by radiation. The four common symptoms of inflammation are present,—namely, redness, heat, pain, and swelling; while the absence of vesication distinguishes this from the next degree. The redness is of a bright rosy hue, diffused—not circumscribed, disappearing momentarily under pressure, and very similar to that of erythema, of which this may be considered a traumatic form. The pain is acute, of a smarting, or burning character, and it generally lasts as long as the rubefaction remains. The swelling is but slight, except when on mucous membranes. These symptoms disappear by resolution in a few hours, or at most, in two or three days. In more severe cases, a slight desquamation of the cuticle ensues in the form of light furfuraeous scales. A degree of tenderness in the part frequently remains for a few days longer.

When the shock has been very great, collapse is present; marked by a weak, fluttering, and irregular action of the heart, and a pulse almost imperceptible at the wrist. The person is scarcely conscious, his sensations are impaired, and his gaze is vacant. When reaction is established, symptoms of any of the complications already enumerated, may exhibit themselves.

Local Treatment of First Degree.—In burns of the first degree, the objects of local treatment are to mitigate pain and prevent effusion. When an extensive surface is affected, the whole should not simultaneously be exposed to the atmosphere; and any necessary exposure should be as brief as possible. In slight burns, local treatment may alone be requisite, consisting in the steady application of cold for several hours, either by simple immersion or wet cloths. Immersion is of course only applicable when the surface involved is small and suitably situated, and when no collapse is present. The water employed must be kept cold by frequent renewal. When the part is not conveniently situated for immersion, it should be closely, but at the same time lightly, enveloped with a single layer of soft linen or cotton kept constantly wet with some cold liquid. Simple water may be employed, with the addition, if thought necessary, of a little alcohol, to increase the evaporation and the consequent cold. Dupuytren used an acetate of lead lotion, which he considered sedative and astringent:—it is a very excellent application. After the incipient inflammation has been thus checked in the onset, the part, if of any extent, must be defended, alike from the stimulus of the atmosphere, and the depressing influence of cold; one or both of which might injure it in its present delicate condition. This may be variously accomplished, either by rolling fine carded cotton or wadding around the part; or by varnishing the surface with a thin layer of some bland adhesive substance, which will, for a time, perform the part of an insensible cuticle. For this purpose, mucilage of gum arabic, or tragacanth, or the ethereal solution of gun-cotton known by the name of collodion,—may be employed. The collodion, and probably the mucilage also, seem to act in two ways;—first, by protecting the surface

from contact with the atmosphere; and—second, by contracting to a certain extent as it dries, which, together with its close adhesion to the cuticle, tends to keep up a degree of pressure or compression, that proves beneficial to the weakened part, as well by affording it support, as by favouring the absorption of any slight interstitial effusion. The varnish may be removed, when the vascular action in the subjacent integument has quite subsided to its natural standard. If applied, however, over a large surface, it might prove injurious by mechanically obstructing the cutaneous transpiration of the part; and this would favour the occurrence of vesication. Such an objection does not apply to cotton. For a like reason, the aqueous mucilages are less objectionable on the large scale, than collodion, which is quite impervious to moisture; while the former readily imbibe a little from the surface below, which not only relieves the subjacent integument, but also prevents undue desiccation of the protective layer, and its consequent cracking and peeling off.

But, where a very large surface is burnt, and when the depression is considerable, the continuous application of cold cannot be had recourse to, as it would tend still farther to lower the system. In this case, a warm opiate fomentation may be employed, which will greatly mitigate the pain; and, subsequently, the cotton or varnish may be employed as before. Some persons employ the cotton in the first instance; and this will be the most judicious treatment in many burns of the first and second degrees, where, from the great extent of injured surface, neither cold nor warm lotions can be conveniently employed. The cotton, moreover, has this obvious advantage, that when once applied in such cases, it need not soon to be disturbed; while liquid appliances, on the contrary, require frequent or constant supervision and renewal. This peculiarity is a decided recommendation for its employment in those distressing cases of great severity, in which all hope of life is at once destroyed; and in which, therefore, the treatment ought from the first, to be chiefly directed to soothe the suffering of the last moments. A popular application, which deserves mention as a ready substitute for the cotton or varnish, after the vascular action has been repressed,—is flour, dusted thickly over the reddened surface. It is applicable to burns of the first degree; but not when the injury has caused, or is likely to induce vesicles; for, on the bursting of these, the effused fluid cakes the flour into a mass, which hardening, irritates, instead of protecting the skin.

Stimulant applications have been recommended from the commencement; but, in the early stages of all burns, they tend to increase the vascular action, and so carry the injury to a higher degree than it would otherwise have attained. Turpentine has been considered to exercise a constringing action on the vessels of the integument, and thus to prevent effusion; but this substance on many skins, even when in the healthy condition, is itself a very powerful rubefacient. In slight burns of the face, from explosions, by which the eye is injured by particles of gunpowder stuck on, or into the conjunctiva, all the large grains should be removed at once; after which, linen cloth, kept very wet with cold water, or a cold, light, very moist, bread-and-water poultice enclosed in a cloth, forms the best application, and is to be laid across the eyes, the patient lying in bed. The water here dissolves

and carries off the nitre of the powder; while its remaining constituents, sulphur and charcoal, are washed away. Those particles which remain after a day or two, should be carefully picked out by any fine-pointed instrument. The operation, which has been advised, of picking out with the point of a needle, all particles of gunpowder that have lodged in the skin, would be, in many instances, where the whole face and head are thus tattooed, as impossible to execute as it would be dangerous and cruel to attempt.

The treatment of pharyngitis, or laryngitis, following an attempt to swallow boiling water, does not differ materially from that proper for acute idiopathic cases of the same nature;—it must be instant and energetic. It consists chiefly of depletion, local or general according to circumstances, counter-irritation, the exhibition of antimonial or mercurial medicine, and the employment of a tepid demulcent gargle. Bronchotomy, as a last resource, should be performed as early as the necessity for it clearly exists, because the ultimate success of this operation as of that for strangulated hernia, depends very much on the period at which it is instituted.

The *Second Degree* of burn is characterized by the presence of vesication, in addition to the erythematous rubefaction observed in the first. The vesicles form where the heat has been most intense, or longest applied. Though generally formed immediately, or very soon after application of the caloric, they will continue enlarging, or new ones may be formed during the next twelve or eighteen hours, if the part has not been properly protected from irritation. The contained serum may be either clear or opaque, colourless or tinged with various shades of yellow and red. Around them for some distance, the first degree of burn prevails, but the swelling and pain are here greater; the latter, when the phlyctenæ are large and full, being accompanied with a feeling of tension. Such is the state of matters, when, as is most commonly the case, a hot liquid has produced the injury; but, when it is occasioned by actual contact with a heated solid, the epidermis frequently adheres to it, and is torn off along with it on its removal. When this happens, the pain experienced from exposure of the denuded surface to the atmosphere, is exceedingly acute, and slight suppuration is almost inevitable. This suggests the propriety of not lacerating the vesicles; or if, to relieve their tension, it be necessary to evacuate part of their contents, of making the opening as small as possible, and then preserving the cuticle otherwise entire until the surface beneath shall have no need of such protective covering. Under favourable circumstances, the detached cuticle dries, and shrivels up in a few days; it then falls off, or may be removed, its place being supplied by a new layer of similar structure, as yet, indeed, more delicate, and of a reddish hue, but which soon assimilates its appearance to that of the original tissue. Even if slight suppuration occur, no mark is, after a time, discernible; but if the purulent secretion be from any cause protracted, a scar or slight disfigurement will ensue, which, however, with time and appropriate treatment, will ultimately disappear.

The *Local Treatment of the Second Degree* of burn differs from that proper for those of the first grade, in so far only as the appliances to

the vesications are concerned. When produced, as this grade usually is, by scalding fluids, some parts covered by the clothes are generally more or less injured; and in the removal of these the greatest possible care is requisite to prevent laceration of the vesicles, or the tearing away of the detached cuticle. If the vesication be slight, the treatment for the first degree may be instituted, taking every care that the elevated epidermis be preserved from injury. But if the subcuticular effusion be very great, the vesicles, as they become large and tense, should be punctured with a small needle. The evacuation of their contents in this way affords much relief; and if the fluid reaccumulate, it may again be discharged in a similar manner. Cold astringent lotions offer the most probable means of limiting the effusion; but these may be counterindicated by various circumstances, which have already been sufficiently explained while speaking of the treatment of the first degree. Glycerine, mingled with an equal quantity of water, has lately been recommended as a topical application in burns of the first and second grades. It certainly has the property of keeping the part soft and moist for a long time. If the cuticle has been torn off, the raw surface, when large, is most effectually soothed and protected by the *Linimentum Aquæ Calcis*; or when small, by forming an artificial crust over it with mucilage, collodion, or the nitrate of silver, which being applied gently to the moist surface, coagulates the secretions, and thus forms a protective layer. Over the thin crust produced by the lunar caustic, a piece of gold-beaters' skin should be applied, to prevent its cracking and premature detachment. The method of healing by incrustation is preferable when the prevention of scars is an important object, as it is when the face, neck, arm, or hand, especially in a female, is the seat of injury.

The *Linimentum Aquæ Calcis*, or Carron Oil, as it is popularly termed, has been employed indiscriminately over the whole of the burnt surface, whether blistered and denuded or not; but its employment in this manner is attended, in some degree, with the same objection formerly offered, as prohibiting the application, over a large area, of a varnish impermeable to aqueous moisture, namely, the checking or prevention of the cutaneous transpiration, which effect is, with justice, believed to increase the subcuticular effusion. The common turpentine liniment, composed of turpentine and resinous ointment, is objectionable on the same account, and is, besides, much too stimulant an application to the blistered surface. If the effusion in the vesicles become decidedly puriform, the raised cuticle must be freely incised, and the surface treated as an ordinary ulcer, should it continue to suppurate; or the incrusting process may be tried, if the secretion of matter be scanty.

The *Third Degree* of burn consists of cauterization of the epidermis, and the papillary or superficial layer of the dermis. Gunpowder explosions are said frequently to produce this grade; and the skin in these cases is permanently tattooed, in many places, by the lodgment of black particles driven into it. In this grade, the part is usually charred at once, or it dies very soon. The eschara, in the slighter cases, are so thin as to resemble mere stain; but in other instances, they may be half a line or more in thickness. They vary in colour, from grayish-yellow to dark-brown; and, in consistence, from a moist and soft state,

to a dry and hard though pliant condition. When the consequence of a scald, they are usually of the lighter hue, and softer consistence; and as, under these circumstances, the vitality of the part has not been instantaneously destroyed, the slough is frequently covered with dark vesications, the fluid contained in which is sanguineous, and of a red or brown colour. These are seldom found over an eschar which has been produced immediately by a solid of high temperature, because the slough thus formed is usually dry and hard. It is in that case also depressed, while the surrounding integument is corrugated and drawn in around it. When present, however, Dupuytren regarded these dark-coloured vesications as extremely characteristic, indeed diagnostic, of this degree of burn. Occasionally, when produced by a solid body which has remained for some time in contact with the skin, or by a metal in the state of fusion, the cuticle, together with a thin layer beneath it, is torn off at the time, leaving the dermis exposed, and of a grayish colour, part of which dies subsequently, so that nearly its whole thickness is destroyed. Immediately around the charred portions of integument, the skin will be found to have suffered to the second degree, as exhibited by the limpid vesicles; and still further off, to be merely affected with the erythema of the first. Dupuytren remarked that, while in every burn the pain is acute, it is much more intense when the skin is burnt only on its surface, than when the injury extends more deeply. Accordingly, the third degree of burn is found to be the most painful of any; though some writers have stated it to be less so than the two preceding varieties. The danger to the constitution, also, is proportionately greater here than in these,—primarily, because the shock is greater and the pain more intense; and secondarily, because the reparative powers of the system will be more largely taxed in this, than in the more superficial injuries. So soon as the parts are quite dead, there is a remission of the pain for a few hours, until inflammation be established, and the process of separation commenced; yet even during this interval, though the eschar itself be insensible to the touch, yet, from its thinness, a very gentle pressure on it, by being transmitted to the living and sensitive structure beneath, will excite acute pain. Upon the supervention of inflammation, there is a reaccession of pain, and it now continues very severe, until a short time after the sloughs have been thrown off; the period of which occurrence varies according to their thickness and the vigour of constitution, from four to fourteen days after the infliction of the injury. The removal of the sloughs must not be hastened by force, on account of the pain which such treatment would occasion. The remaining sore is superficial, and generally cicatrizes rapidly. The resulting cicatrix is at first redder than the surrounding integument; but subsequently it becomes preternaturally white; its surface depressed, smooth, and imperfectly papillated; or sometimes, when suppuration has been prolonged, it is marked by irregular lines, ridges, and corrugated knots. The local result is, therefore, disfigurement.

The *Local Treatment of the Third Degree* of burn, will be related along with that proper for the fourth, as the same case usually presents the characters of each. It will be sufficient, at present, merely to mention the formation of an artificial crust, by some of the methods already

described, as being very applicable when the eschar is thin, and most desirable when it is on exposed parts, as the cicatrix, obtained in this way, is much more perfect and similar to the original integument than that resulting from ordinary granulation.

The *Fourth Degree* of burn is generally produced by the actual contact of a solid body at a high temperature. In this case an eschar is at once formed, comprehending the whole thickness of the skin, and frequently, also, the subcutaneous cellular tissue. It is here dark brown, or black in colour; dry, hard, and leathery, yet brittle, in consistence; and is quite insensible, pressure producing little or no pain, even in structures naturally the most sensitive,—the dermis being completely destroyed. Owing to the fluids having been thus almost instantaneously expelled from the carbonized integument, diminution of its bulk necessarily ensues, both in its thickness, and its superficies. The eschar is consequently depressed below the level of the surrounding skin, and the latter, still more than in the third degree, is drawn in around it, exhibiting numerous puckered folds or corrugations radiating from the margin of disorganization. When the part dies more slowly from the violence of inflammatory reaction, the slough is softer and less depressed. Its thickness varies from one to three lines, being, for the same depth of destruction, thinner in the hard and dry variety, because of its greater density and compactness, than in the soft and moist form, which is more loose and flabby in its texture. Receding from the point where the heat has been most intense, the three minor grades of burn are generally observable; that of the most superficial character occupying the most distant site. The pain is severe so long as the application of the cauterizing agent is continued; but upon its removal it ceases, at least in that spot, for a few hours, during which time, little more than uneasiness may be felt in the part which bears the characters of this degree, because the structure which would have been most acutely sentient, had its vitality been preserved, has been at once destroyed. If, however, the neighbouring surface be affected in a more superficial manner, then the pain, already described as attendant on burns of the first three degrees, will be experienced. Even if the latter condition should not exist from the first, it will ensue, in the course of a few hours, and severe pain will then become developed from inflammation attacking the integument around.

In three or four days, the parts beneath the slough have, from the same cause, become painful; and both cause and symptom increase in severity during the first week, at the expiration of which period, or about the ninth day, their intensity begins to decline, and afterwards suffers a gradual diminution, which is contemporaneous with the establishment of the process of separation between the dead and living structures. The process of ulcerative absorption by which this is effected, having been described in another part of this work, need not be related here. The separation is effected during the third week after the infliction of the injury. Granulation now proceeds, in some cases, with sufficient activity; but very often it assumes the indolent character, and is attended with profuse suppuration, when the surface is of large extent. The cicatrix, when at last completed, is, as before explained, much smaller than the

original destruction of integument; it is permanently depressed, of a fibrous appearance, smooth unless cicatrization has been irregular; possessed of little common sensibility, and very liable to chafe and ulcerate. Thus by its appearance it constitutes, at least, a disfigurement; while by its contraction, or adhesion to parts beneath, serious deformities may be produced, attended probably with much loss of motion.

Previous to separation of the slough, or at least until that condition be considerably advanced, it is often difficult, if not impossible, to pronounce with certainty whether a burn be of the third, fourth, or even of the fifth degree; especially in situations where the bones are but thinly covered by soft parts; because the secondary sloughing, consequent on the inflammation, which attains its height about the ninth day, is frequently so extensive and profound, as to make an eschar, which at first seemed inconsiderable, become subsequently of very formidable dimensions. A knowledge of the manner in which the injury was produced as regards the nature of the agent, and the mode and duration of its application, will assist in forming an idea as to how far the caloric may have penetrated.

The following remarks will usually enable the *primary* amount of destruction to be ascertained. The present degree is distinguished from the third, by observing that in this grade, severe pressure on the eschar at an early period produces little pain; while in the more superficial lesion, gentle pressure produces intense agony. As before explained, there may be here also very acute pain from the commencement, owing to a superficial inflammation of the surrounding skin, and until pressure be actually made on the primary slough, the patient's sensations may not be so well defined as to inform him, that under it at least, there is little or no pain. From a burn of the fifth grade, the present degree is distinguished by its comparative want of sonority or resonance on percussing the eschar, which property, if present at all, can, from the thinness of the slough, exist only in a very slight degree; while in a burn of the fifth grade, a distinctly sonorous sound is elicited from the eschar. Of course, in any case, where the slough is of the soft and moist description, percussion is useless, and could produce no distinctive sound.

The *Local Treatment of the Third and Fourth Degrees* of burn comprises four indications; namely—to regulate the amount of inflammation; to favour separation of the sloughs; to assist the processes of granulation and cicatrization; and to prevent, or in some cases, to modify, deformity. The first indication, which is to regulate the amount of inflammation, requires that its activity should be repressed when excessive; and that when defective, local reaction should be promoted, because a certain amount of vascular action is necessary to effect the detachment of the eschar, and the subsequent cicatrization of the sore. To limit the inflammation, an elevated and relaxed condition of the part should be preserved. If it prove excessive, so as to threaten extensive secondary sloughing, local depletion may be required; in estimating the necessity for which, the character and degree of the general symptoms of pyrexia will render valuable guidance. In robust and plethoric adults, in whom, from the injury being of small extent,

the system has been little depressed, the early abstraction of blood by leeches, may limit very considerably the impending destruction of tissue. These should be applied, when the collapse has quite worn off, as near as possible to the threatened part. Perhaps in a few rare cases a moderate general bleeding may be advisable, in order to restrain the local action; but either form of depletion must be employed with the *utmost* caution, and in as sparing a manner as will suffice for the attainment of the immediate object in view; more especially when the amount of destruction has been great, because, as will afterwards be mentioned when describing the constitutional treatment, the powers of the system may be injudiciously weakened, when ere long it will have need of all its energies to carry on the work of reparation.

On the other hand, when local and general reaction prove very tardy and defective, stimulant applications must be resorted to, in order, first—to excite a sufficient amount of local inflammation to throw off the slough; and, secondly—through this medium to assist in rousing the system from collapse. For this purpose, the liniment composed of resinous ointment and turpentine, may be applied, and its stimulant properties regulated by varying, when necessary, the quantity of the latter ingredient. The manner of fulfilling the second indication, which is to promote separation of the slough, may vary a little under different circumstances. The warm water-dressing, consisting of cloths dipped in warm water, and covered with oiled silk to prevent evaporation and cooling, is usually the best appliance; and if there be much pain the water may be medicated with opium. Light poultices answer the same purpose, but if large, they prove, from their weight, especially when on the trunk, distressing to the patient. If the inflammatory action be very weak the applications may be rendered stimulant by the addition of a metallic salt. No mechanical force must be employed to detach the eschars; but if a large piece be loose except at one point, the greater portion of it may be cut off near the point where it is still attached. Occasionally matter forms under a part of the eschar, and, accumulating, gives rise to pain and tension. Fluctuation is perceptible at the part, and free incision of the slough is requisite to permit the escape of the purulent collection. The third indication, which is to promote granulation and cicatrization, comes into play immediately subsequent to the separation of the eschar; when the usual treatment of granulating sores, as described while treating of the results of inflammation, is to be instituted. If there be much foetor, a weak solution of the chloride of zinc, or of soda, may be advantageously employed.

If the sore lose its vigorous character, and become indolent, the part, especially when on an extremity, should be encircled with a lightly-applied bandage, which not only affords support, but, by the gentle pressure which it exerts, tends to prevent that flabby exuberance of granulation which is so liable to occur, and so certain, if it do occur, to retard cicatrization.

It is proper here to mention that these injuries have been, and are sometimes at the present day, treated differently, by means of unctuous applications, by cotton, &c. The former of these are, however, by no means so cleanly as the water-dressing. The Unguentum Calaminæ,

and *Oleum Palmæ*, are probably the least objectionable of them ; and it is advised to spread them thinly on lint, in which a number of small apertures have been made, so as to permit the free escape of matter from beneath the immediate dressing. The surface is also dusted over with vegetable charcoal by some surgeons, with the intention of thereby sopping up the profuse discharge. This is certainly not a seemly application ; and its use, when possible, had better be avoided, as the washing, required at each dressing to remove this substance, cannot be beneficial to the tender granulating surface. With regard to cotton, the application of which has been recommended in numerous layers, Professor Miller justly remarks, that in these severe burns, it " would speedily become soaked with the discharge, and either require frequent renewal or else prove a very hotbed of pestilential putrescence."

The fourth indication, which is to prevent, or, in some cases, to modify deformity arising from the centripetal tendency of the structures around the burn, during and after cicatrization, is accomplished chiefly by preserving the parts in such an attitude that the tissues must be approximated longitudinally as regards the long axis of the body, rather than in the transverse direction. For it will be observed that contraction of the cicatrix in the former way, will rarely produce deformity, though it may cause a degree of tension and stiffness ; while in the latter direction, serious impairment of motive function may readily be induced, from fixation of a joint even in a convenient attitude, or, what is more common, in an extremely awkward and sometimes an absolutely dislocated position. In order to obviate this, the position of the part during the progress of cicatrization, and for some time after its completion, must be so ordered that it will oppose any such malposition of the joint implicated. The period of complete cicatrization may be thus somewhat deferred ; and if, during this delay, hectic should supervene, or prove more urgent, all opposition to Nature's own manner of cure must be desisted from, and subsequent measures trusted to, for the palliation or removal of any deformity which may have accrued from it. The contraction can be moderated, and its direction regulated, in many situations, where bandages would have no effect, as on the face, neck, and some parts of the limbs, by strips of isinglass plaster. As there is at the angles of commissure of the fingers and toes a great tendency to union of the opposed surfaces, the dressing must be carefully inserted between them up to the top of the fissure, and a turn of a bandage brought above, so as to exert a steady pressure on the part. Natural orifices must be kept, by appropriate mechanical means, from closure or constriction, during cicatrization in their neighbourhood. To prevent fixation of a joint, either from contraction of the tissues or from its long continuance in one attitude, passive motion must, in the latter stages, be cautiously instituted, and the exact position of the articulation varied a little from day to day. But in many cases the destruction has been so profound, or so extensive, that partial or complete loss of motion must inevitably ensue. In these instances, the joint, during treatment, must be preserved in that condition, as to flexion and extension, which will render the limb most useful if spurious ankylosis occur. This position, in the elbow, will be semiflexion, the forearm being bent nearly

to a right angle with the arm, and, in the knee, almost complete extension.

Amputation can seldom, if ever, be requisite in burns of the fourth degree, except in rare cases of very profuse and obstinate discharge from an extensive surface, in which the hectic proves imminent; or when the soft structures over the bone are exceedingly thin, and are destroyed all around it, which occasionally happens in the fingers and toes, a burn of the fourth class in these situations being *locally* as severe as one of the fifth grade in better protected parts.

The *Fifth Degree* of burn consists of a disorganization—not only of the skin, but also of the subjacent soft parts to a variable depth, occasionally down to the bone itself. In this case the primary eschar when produced instantaneously, or at least rapidly, by incandescent or burning bodies, is black, depressed, and dry; hard and sonorous on percussion. When the part dies more slowly, in consequence of the heat having been less intense, or applied for a shorter time, the slough is softer and more moist. It is quite insensible to pretty severe pressure until inflammation has set in, around and beneath it, when of course pain accompanies the vascular action, and is aggravated by pressure. During the violence of this reactional process, secondary sloughing of the tissues is very apt to occur. Arteries and nerves sometimes preserve their vitality in midst of the disorganization, for several days. More commonly, however, they perish at the same time with the other tissues, and if they happen to be large or important trunks, gangrene of the distal parts supplied by them may possibly be the result. The minor degrees of burn will usually be observed in more or less regular gradation, receding from the point where the heat has been most intense; but independently of this source, pain becomes developed in a few hours after receipt of injury, from inflammation arising in the superficial parts immediately around the eschar; and owing to the same circumstance, during the second week, pain on pressure is elicited, gradually extending from the circumference to the centre of the slough, as the vascular action increases beneath it. At the expiration of that period it begins partially to separate; the most highly organized structures being the first thrown off. In persons of bad constitution there is at this time danger of hemorrhage from arteries which have suffered solution of continuity, and which, owing to the vitiated state of the system, have not been occluded previous to the exposure of their extremities. Pieces of tendon remain frequently for several weeks undetached if not cut away; and if bone have become necrosed, the exfoliated portions may not be thrown off for a much longer period. After an extensive injury of this severe character, the system requires some time to rally; and it is not, in general, until two or three days after its occurrence that reaction is fully established. During, and for a considerable time after the separation of the slough, the suppuration is very foetid and abundant. Owing to the depth of the sore, healing advances very slowly. Muscles, tendons, and aponeuroses become adherent to each other, and contribute to form the cicatrix, which, when at last completed, is uneven and irregular, and effectually prevents any motion of the parts which have assisted in its production. The local results of this degree of burn may

be any of the different varieties of deformity or mutilation, attended by corresponding impairment or loss of function.

The *Local Treatment of the Fifth Degree* of burn is precisely similar to that already indicated as proper for like injuries of the fourth grade. Amputation is requisite in burns of this degree under the following circumstances:—First, when upon separation of the slough, the interior of a large articulation, such as the knee or ankle, is laid open. Second, when the same result follows inflammation and abscess in its interior. Third, when a large portion of bone is exposed on the detachment of the eschar, a condition which would induce extensive necrosis. Fourth, when the loss otherwise is so great as to hold out little expectation of the sore healing; or, if that should take place, of the limb, thus preserved, proving anything but an incumbrance to its possessor. Fifth, at a later period, amputation may be called for to save the system from sinking beneath the hectic consequent on profuse and prolonged suppuration.

The *Sixth Degree* of burn, which consists in the complete charring of the whole thickness of a part or limb, is easily recognised by the part thus incinerated being shrunken, hard, totally insensible to the severest pressure, brittle and distinctly sonorous on percussion. This primary eschar is black in colour; and when produced at once by the limb being enveloped by metal in a state of fusion, the line of destruction proceeds from the surface almost directly down to the bone; but when the carbonization has been more slowly effected, the eschar proceeds more obliquely through the tissues, gradually penetrating more deeply as it approaches the point of actual contact with the burning body, at which part everything, including the bone itself, is involved in destruction. The secondary sloughing, however, brings both cases nearly to the same condition in this respect, and when the eschar is thrown off an irregular and conical stump remains, of which the bone forms the most projecting part, destined, ere cicatrization be effected, to die and exfoliate. The inflammatory reaction and separation of the slough go on here in a similar manner; but the latter requires a longer period for its accomplishment than in burns of the fifth degree. Mutilation, the most severe of the local results, is the inevitable consequence of this grade.

The *Local Treatment of the Sixth Degree* of burn consists usually of amputation. As the detachment of so thick an eschar is necessarily a work of considerable time, and as the stump then left is a very undesirable one, it is proper, unless counterindicated by the existence of some unusual circumstance, to amputate in every burn of this grade. This is to be done so soon as the collapse has gone off, and before the super-vention of the inflammatory, or, it might be, of the irritative fever, which otherwise would occur.

The *Constitutional Treatment of Burns* comprises five indications; namely—to promote reaction; to control and regulate its intensity; to watch for and treat inflammatory affections of the internal organs; to support the system under hectic and its complications; and lastly, to remove mechanically, under certain circumstances, the cause of the hectic.

The *first* indication then of general treatment is to promote reaction.

It is said that reaction is mainly brought about by the severity of the pain ; but this must only be when the pain is under a certain degree of intensity, for it is well known that this symptom, when excessively severe, itself exercises a powerfully depressing influence upon the heart's action. In many cases nature is able herself to rouse the system ; but if not, reaction is to be promoted, when the patient can swallow, by the administration of some of the diffusible or more permanent stimuli, such as ammonia and brandy, in small and frequently-repeated doses. When the general surface and the extremities are cold, warmth should be applied, and, if practicable, sinapisms to the feet and pit of the stomach ; but the effect of these must be closely watched, lest they induce sloughing. Opium has been recommended in large doses to diminish the pain, but this will tend to increase still further the cerebral congestion, which dissection has proved to be so common at this stage ; while, on the other hand, small doses will have no effect. The pain should in these cases be relieved, as far as possible, chiefly by topical remedies. When the collapse remains long, a warm and slightly stimulant enema may be administered, and repeated if necessary.

This stimulant treatment, during collapse, must not, however, be carried too far ; and it is to be suspended so soon as signs of approaching reaction appear ; for otherwise, when that stage is fairly established, the persistent effects of a superabundant stimulation, or, in other words, its surplus would exaggerate the reaction, which would now require as active treatment in the opposite direction, and when subdued, if indeed not fatal, the system would be much more enfeebled than it would necessarily have been, had nature been left a little more to her own resources during her efforts to institute reaction.

When, as stated before, premature and asthenic reaction comes on, marked by great irritability and nervous excitement, with a rapid, throbbing, but feeble pulse, the exhibition of opium, in large doses, is attended with the most beneficial results.

The *second* indication is to regulate the intensity of the reaction. When it proves excessive, without apparently any internal organ in particular being attacked, the antiphlogistic regimen will in general be sufficient. In very few burns is bloodletting in any form required, or, indeed, in hospital practice, admissible ; but it may possibly be demanded, in a few cases, to relieve the general inflammatory state of the system ; and at the same time, to moderate the local action, and thus limit the amount of secondary sloughing. In having recourse to these depletive measures, however, it must never be forgotten that, in all burns, except those of the first and second degrees, the powers of the system may at no distant day be taxed to their utmost to support suppuration, perhaps large in quantity, prolonged in duration, and secreted by an extensive surface. Accordingly, the slightest unnecessary lowering of the system will entail a still more profuse and protracted suppuration,—a still more tedious and possibly imperfect cicatrization.

The *third* indication relates to the inflammatory affections of various organs which may occur. Their onset is often very insidious, and so must be watched for. They are to be treated in accordance with the ordinary medical principles applicable to each particular complication.

Bloodletting, when necessary, should be as moderate as possible, for the reason already specified; and also on account of the well-established principle, that depletion cannot be borne to the same extent in secondary inflammations after a shock or injury, as in a primary or idiopathic affection of the same nature.

The *fourth* indication is to support the system against hectic, and its complications. The appropriate treatment has been described when speaking of Hectic Fever. Over-stimulation must be guarded against, as this, equally with debility, impedes cicatrization by inducing flabby and exuberant granulation. The bed-sores, resulting from long-continued pressure on the salient points of the back, sacrum, nates, and heels, exercise a very depressing effect. When threatened, a strong spirit-lotion is an excellent application; or, if already formed, the part may be pencilled with nitrate of silver. Under the crust thus produced, the part, if relieved from further pressure, will readily heal. Arnott's water-bed, or a Mackintosh air-cushion, affords great relief by equalizing the pressure over the whole decumbent surface.

The *fifth* indication is to remove mechanically, when necessary, the cause of the hectic. Amputation, though frequently performed to fulfil a merely local indication, namely, the removal of an useless limb, is sometimes necessary for the sake of the constitution. Thus, if hectic be extremely urgent, the suppuration continuing very profuse, with a large surface still remaining for cicatrization, while the amount of the former is not satisfactorily diminished, nor the rapidity of the latter materially increased by remedies, then amputation must be performed in order to save life.

Suppuration may be prolonged, and cicatrization delayed—from debility of system—from an extensive surface being involved—from bone having become necrosed—and from the opening of a large articulation, either by the sloughing of the tissues, or subsequent to inflammation and abscess in its interior.

Affections of the cicatrix.—This structure is very liable to excessive contraction, to chafing, fissure, ulceration, and irritability. With regard to the first of these conditions, Professor Syme remarks that the cicatrix, when recent and still soft, may be gradually stretched. In an instance on the upper extremity, the successful extension was conveniently effected by a strong iron-wire splint, which can be made in a few minutes, of any form, and when covered with soft washed leather is extremely useful. This splint admits of being straightened a little daily; while it has sufficient rigidity to overcome the resistance of the cicatrix. When, however, the latter has become hard and unyielding, it cannot thus be stretched; and attempts to do so have led to great pain, inflammation, and even gangrene of the lately-formed structure. Sometimes a few incisions, made through it, transversely to the desired line of extension, may relieve the contraction; but in many cases, nothing but a plastic operation will succeed. This consists in making an incision in the cicatrix, so arranged, as to permit the limb to be placed in an extended and unconstrained position, in which it is to be maintained: a flap of integument, corresponding in form with the surface exposed by separated edges of the incision, is then dissected from some convenient

part in the neighbourhood; preserving, however, at one part its connexion undestroyed, by which it is to be nourished until fairly attached in the new situation to which it is now transferred, retention till that time being effected by sutures and plaster. The wound occasioned by its removal is treated on common principles, and the connecting slip divided, if necessary, so soon as perfect adhesion has occurred. Another operation, which has been practised with success, consists in making two incisions in the form of the letter V, in the line of required extension, embracing the scar and meeting at a point on the sound integument below. The flap, consisting of the cicatrix with a narrow border of sound integument, is dissected up, from its apex towards the base; till the limb can be extended, and is then laid down on its now somewhat altered situation; the edges of the whole wound being brought together laterally. They are secured in the usual mode, and the lines of incision are now found to resemble the capital letter Y.

As the cicatrix, like all newly-formed structures, is very susceptible of absorption, the hard prominences, occasionally presented by it, can usually be removed by the steady pressure of some smooth and unyielding substance lightly applied; but if this fail, they may be cut out. The chafing, cracking, and ulceration to which the scar is liable are frequently very distressing. Slight injuries suffice to abrade its surface; it frequently cracks when much over-stretched during motion of the part; and ulceration may follow either of these conditions. To guard against these states, all of which may likewise be induced or aggravated by cold, the cicatrix should if possible be kept well defended from external influences by a warm, soft, and fleecy covering, and by strict attention to cleanliness. But the same conditions sometimes arise spontaneously, as it were, or from some constitutional cause, which, if discovered, is to be rectified. When the fissures proceed from cold or other external irritation, glycerine, if it prove equally serviceable here, as in common cases of "chopped hands," will speedily effect a cure.

The cicatrix, though little sensible to touch, is often morbidly sensitive to atmospheric changes, and is frequently the seat of uneasy sensations, which sometimes are so severe as to merit the name of neuralgia. These symptoms occasionally depend on the trunk or branch of a nerve being involved in the cicatrix; but much more frequently no such cause can be discovered. In the former case, an operation for the excision or disentanglement of the implicated nerve could alone be expected to afford relief; and in the latter instance the usual treatment for neuralgia must be instituted.

CHAPTER V.

FRACTURES.

GENERAL DOCTRINES.

A FRACTURE, or solution of continuity of a bone, is said to be transverse, oblique, or longitudinal, according as it is at a right or an acute angle with, or parallel to, the long axis of the part of the bone in which it is situated. Where the condition of the bone, and that of the surrounding parts, is made the basis of arrangement, fractures may be divided into the following classes, namely—Simple, Compound, and Complicated fracture, Fracture with wound, Impacted, and Partial fracture. A fracture is said to be *simple*, when a bone is broken at one part without any coexisting injury of soft parts; *compound*, or *open*, when there is an open wound of the superimposed parts, communicating with the fracture; *comminuted*, when the bone is broken into several fragments; *complicated*, when, together with the fracture, there is serious injury of the adjoining structures, as laceration of vessels, or of other important parts, or serious contusion of the superimposed tissues; *fracture with wound*, when the wound does not communicate with the fracture; *impacted*, when one fragment is lodged in the other; and *partial*, when the continuity of only part of the osseous fibres is interrupted. This last variety has been called by some *bending with partial fracture*, and by others green-stick fracture. Bending sometimes takes place without fracture; but I have seen cases which I am convinced were cases of bending with partial fracture.

The principal symptoms of fracture are pain, obvious deformity, preternatural mobility, crepitus, and inability to move the affected limb; but as the symptoms and causes of the particular fractures will be minutely described, it is unnecessary to refer to them under the head of general doctrines.

The mode of union.—Baron Dupuytren made many experiments in dogs, rabbits, birds, and other animals, and, as the result of those experiments, he arrived at the conclusion that nature never accomplishes the union of a fracture without two successive deposits of callus, the one of which he names the *provisional*, the other the *permanent*. The first he believed to be perfected in from thirty to forty days—the production and complete organization of the other, he believed, required eight, ten, or twelve months.

Dupuytren arranged the phenomena, from the occurrence of the fracture to the exact and complete reunion, into five different periods or stages.

In the first stage, comprehending a period of eight or ten days, blood is extravasated into the medullary canal, between the fragments, and under the periosteum, raising up the latter from the bone for some distance above and below the fracture. The medullary membrane becomes swollen and separated from the bone, and the periosteum is not only raised up from the bone, but it also becomes red, soft, swollen, and preternaturally vascular. The fragments of bone may thus be said to be surrounded with blood, which not only fills the medullary canal and the space between the fragments, but also separates the latter from detached periosteum. This blood becomes absorbed, and liquor sanguinis is effused into the parts at first occupied by extravasated blood.

In the second stage, comprising the interval between the tenth or twelfth day to the twentieth or twenty-fifth, the tumour of callus, as it is called by Dupuytren, is formed. The substance between the periosteum and bone is converted into a structure like fibro-cartilage, and within the medullary canal there is also developed a fibro-cartilage, but the substance between the fragments retains the appearance of coagulable lymph.

In the third stage, extending from the twentieth or twenty-fifth to the thirtieth, fortieth, or sixtieth day, according to age and strength, the fibro-cartilage between the periosteum and bone, and that within the medullary canal, are both converted into bone, the external forming a ring, or ferule, or clasp, and the internal a plug, or peg (cheville), filling up the medullary canal, and together constituting what Dupuytren calls the provisional callus. The external ring, embracing both fragments, and the plug within the medullary canal, constitute nature's provision for keeping the fragments in apposition and at rest. The substance between the fragments is, during this stage, changed into fibro-cartilage.

In the fourth stage, extending to the fifth or sixth month, it is converted into bone, constituting what Dupuytren called the permanent or definitive callus.

The fifth stage extends from the fifth or sixth month to the tenth or twelfth, during which the provisional or temporary callus, being no longer necessary, disappears, and the medullary canal is restored.

Such are the views of Dupuytren on this interesting subject; and, until lately, they were generally received as the correct explanation of the successive changes that take place, both in man and in the lower animals, from the occurrence of fracture until the injury is completely repaired.

Mr. Paget, in his "Lectures on Repair and Reproduction," after injuries, has brought forward different views from those which formerly prevailed regarding the repair of a fractured human bone, and has supported his opinions by most conclusive evidence. His views on this subject are in accordance with those of Mr. Stanley. An interesting and full account of them will be found in Mr. Paget's very instructive lectures, delivered at the Royal College of Surgeons of England, and published in the *Medical Gazette* for 1849.

In reference to the description given by Dupuytren and others, of the examination of fractures in dogs, rabbits, birds, and other animals, Mr.

Paget remarks :—"All that is written in these accounts of external and internal, provisional callus and definitive callus, of the formations of cartilage and bone within the medullary tube, and beneath the periosteum, can be traced only, as it were, in rudiment in the fractures of the human bones. There is scarcely a specimen in the Museum of such provisional callus formed in the repair of a fractured human bone; in nearly every case of such fracture, the material of repair is only inlaid between the broken surfaces, or between the adjacent parts of the fragments, and unites them by being fixed to both. In favourable conditions, this appears to be the usual mode of repair, even though the fragments of the broken bone be very much displaced. I have examined many more specimens, and find the same rule true; namely, that in the ordinary repair of simple fractures in the human subject, the reparative material, or callus, is merely inlaid between the several fragments; it fills up the interspaces between them and the angles, at which one fragment overhangs another, but it does not encircle or ensheath them in the manner explained in the description of provisional callus; nor is it in any considerable quantity, if at all, deposited either beneath the periosteum or within the medullary tube. In birds, dogs, and other ordinary subjects of experiments, the formation of a provisional, or, as it may perhaps be better called, an ensheathing, callus is usual."

In evidence that the reparative material is placed not within and around the fragments, as an ensheathing, but between them, as an intermediate callus, Mr. Paget not only adduces many fractures long after they have been completely healed, but as these might be deemed insufficient, he refers also to many recent specimens, at four, five, six, eight, nine, eleven, twelve, and sixteen weeks, and many others at unknown dates after the fracture. The only exceptions to the difference in the mode of repair of human bones and those of the lower animals, the only instances in the human subject in which, under ordinary circumstances, provisional callus is formed, are in fractures of the ribs, and, although much more rarely, of the clavicle.

According to Mr. Paget, other remarkable differences between the reparative process in man and in the lower animals, are—that in man no change of any importance occurs for a week or ten days, and the periosteum remains without being raised up or in any way particularly changed, except that it becomes slightly thickened and more vascular.

The first new material produced is liquor sanguinis, which, according to Mr. Paget's observations, sometimes passes into perfect fibrous tissue, sometimes into fibro-cartilage, and, occasionally, although very rarely, into true cartilage. On this subject Mr. Paget remarks :—"In different specimens, or sometimes in different parts of the same, the reparative material may display—in one, fibrous tissue, with a few embedded corpuscles, like the large nearly rounded nuclei of cartilage cells; in another, a less appearance of fibrous structure, with more abundant nucleated cells, having all the character of true cartilage cells; and, in a third, a yet more perfect cartilage."

Treatment.—The local treatment of simple fracture may be said to consist in fulfilling the four following indications :—first, bringing the fragments into a proper position, which is technically called reduction,—

this should be done as soon as possible; second, maintaining the parts in this position, or preventing any displacement; third, preserving the parts at rest until union be accomplished; and fourth, obviating any untoward symptoms. The proceedings to be adopted for fulfilling these indications will be minutely explained in the description which will be given of the treatment suitable for each particular fracture.

SPECIAL FRACTURES.

FRACTURES OF THE FOREARM.

Fractures of the forearm are more frequent than those of any other part of the body. Desault found, in the record which he kept of such cases, that they occupy the first place. Baron Dupuytren arrived at the same conclusion, as the result of his experience at the Hôtel Dieu; and Mr. Lonsdale also, who gives a table of nineteen hundred and one cases, found these to be the most frequent, and to form one-fifth of all fractures.

In treating of these fractures, it is proposed to consider—First, The Classification, or arrangement of them; Second, The Comparative Frequency of Cases belonging to each Class.; Third, The Symptoms and Nature of the Displacement peculiar to each Fracture; and, Fourth, The Treatment proper to each Class.

I. CLASSIFICATION.

Fractures of the bones of the forearm may be divided into three classes:—

1. Fractures of the radius,
2. Fractures of both bones, and
3. Fractures of the ulna.

II. COMPARATIVE FREQUENCY OF CASES BELONGING TO EACH CLASS.

From the following statistics of the Hôtel Dieu, it appears that the cases belonging to the first class are more numerous than those of the second; and the second more numerous than the third. Baron Dupuytren records, that in 1829, there were brought to the Hôtel Dieu one hundred and nine fractures, of which twenty-three were of the forearm, and of these sixteen were of the radius alone, five of both bones, and two of the ulna alone: and that, in 1836, there were ninety-seven fractures, of which twenty-two were of the forearm; and of these, sixteen were of the radius, four of both bones, and two of the ulna alone. These results are in accordance with the experience of most surgeons. But Mr. Lonsdale has given a table exhibiting a different result as to the comparative frequency of cases of the second and third classes. He found that of three hundred and eighty-six fractures of the forearm, one hundred and ninety-seven were of the radius alone, ninety-six of the ulna, and ninety-three of both bones. These statistics show that by far the greater proportion of fractures of the forearm, are fractures of the radius only;—a fact not difficult to be accounted for, when it is remembered that the radius may not only be broken by direct violence

applied to itself—to which it is also more exposed by its position as the outer bone,—but also by violence applied to the hand, which is supported by the radius.

Fractures of the right radius are more frequent than of the left. Baron Dupuytren found that of ninety-seven cases, fifty-nine were of the right, and thirty-eight of the left radius.

III. SYMPTOMS AND NATURE OF THE DISPLACEMENT PECULIAR TO EACH FRACTURE.

FRACTURES OF THE RADIUS.

1. *Situation.*—Fractures of the radius may take place in any situation; they occur more frequently at the lower, than at the upper extremity, and still more frequently about the middle of the bone. M. Velpeau states that fracture of the ulna is found more frequently below than above, and of the radius, on the contrary, more frequently above than below. This he probably inferred from the circumstance that the lower extremity of the ulna is smaller than the upper, while the reverse is true with regard to the radius. Most surgeons, however, maintain that fractures of the radius are not so frequent at the upper as at the lower extremity.

Fracture at the neck is an exceedingly rare accident. Sir Astley Cooper says:—"This fracture I have heard mentioned by surgeons, as being of frequent occurrence, but there must be some mistake in the statement, for it is an accident which I have never seen; and if instances ever present themselves, which I do not mean to deny, they must be very rare." M. Velpeau's statement with regard to the ulna agrees with general experience.

2. *Causes.*—The radius is fractured by violence, applied either directly to the bone itself, or indirectly through the hand; for instance—when a person falls on the hand, the radius receives the shock from the hand, the upper part receiving the whole momentum of the body from the humerus, while the lower part rests against the hand upon the ground; the radius bends, and, if the force be sufficiently violent, gives way—generally near the middle. This fracture is more frequently occasioned by a fall on the palm than on the back of the hand. Out of fourteen cases, Baron Dupuytren found that three were owing to falls on the back of the hand, and eleven to falls on the palm. Cruveilhier, therefore, was mistaken in believing that the radius could not be fractured by a fall on the back of the hand.

3. *Symptoms.*—Pain, loss of the power of voluntarily effecting the movements of pronation and supination, and the prone position of the hand, are indicative characters of this injury. There are also other symptoms which deserve attention, namely, a motionless condition of the head of the bone during pronation and supination, crepitus, a diminution of the transverse measurement of the forearm occasioned by the fractured portions falling into the interosseous space, and projection of the fractured ends on the back of the forearm, when the hand is very forcibly bent. If the fracture be in the middle, or in the lower two-thirds, it may be felt by the finger.

The *motionless condition* of the head of the radius may best be ascertained by the surgeon grasping the upper part of the forearm with one

hand, having his thumb firmly pressed on the head of the bone, while with the other hand he takes hold of the hand of the patient on the suspected side, and forcibly performs pronation and supination. A motionless condition, under these circumstances, indicates fracture—mobility is a proof of integrity. This is a most useful guide to diagnoses when the fracture is in the upper part, in which case, from the bone being covered by muscles, the other symptoms are more obscure.

Crepitus, which can best be discovered during the above method of examination, is a sure symptom of fracture. It has been called *crepitus*, or *hard crepitus*, to distinguish it from a soft crackling sensation sometimes produced by effusion into the soft parts. The absence of *crepitus*, however, will not prove the non-existence of fracture; for *crepitus* may be prevented altogether by the presence of muscular fibre between the broken extremities, or it may be rendered not very perceptible, in the first instance, by the effusion of blood, or, at a much later period, by the secretion of lymph.

Diminution of the transverse measurement of the forearm, occasioned by the fractured portions falling into the interosseous space. This symptom is most apparent when the fracture is near the middle; it can be increased by pressing the bones near the fracture, or by forcibly bending the hand to the radial side of the forearm.

When the fracture is in the upper third, this symptom is not very perceptible. When the fracture is very near the wrist, the fractured

Fig. 17.



portions often occasion such a pressure upon the tendons as to prevent the motions of the fingers, and sometimes the swelling from effusion into their sheaths gives the appearance of a dislocation. The accompanying sketch, from Liston, is very characteristic of fracture near the wrist.

4. *Position of the fractured portions.*—If the fracture be near the middle of the bone, the part above the fracture remains in its natural position; the part below is drawn too far backwards or forwards, following the movements of the hand when pronated or supinated, and can only be kept in a line with the upper part when the hand is midway between pronation and supination; it is also drawn too near the ulna by the pronator quadratus muscle; hence arises the diminution of the interosseous space. When the radius is fractured at its neck, the inferior part is drawn upwards, inwards, and forwards, by the biceps muscle, while the head and fractured neck are drawn slightly outwards by the supinator radii brevis.

FRACTURE OF BOTH BONES.

Causes.—Fracture of both bones may be caused by a blow, or by a

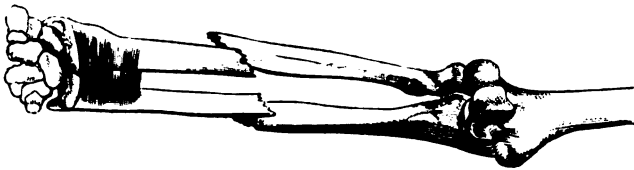
heavy body passing over the forearm,—in which cases the bones are usually fractured in the same situation; or by a fall on the hand, when the radius, which in the first instance receives the whole shock, is fractured, and the ulna, to which the shock is thus transferred, gives way likewise. In the latter case the bones are not necessarily fractured in the same situation.

There is a difference of opinion among surgeons respecting the usual situation of the fractures, when both bones are broken; some supposing that they are generally in the same situation, while Velpeau and others maintain the contrary opinion. In explanation of this difference it may be stated, that the fractures, if produced by violence applied to the hand, will not be in a line, as the weakest part of each bone will give way; but if the fractures be the result of direct violence, they will in every probability be in the same situation.

Symptoms.—The symptoms are,—pain increased on moving the parts, loss of the power of pronation and supination, tumefaction or some unnatural appearance, for the most part an apparent decrease of the diameter of the forearm from side to side by the diminution of the interosseous space, and increase of the antero-posterior diameter by the muscles being forced out from between the bones; angular deformity, apparent on raising the forearm; mobility in a part which ought to be inflexible; and crepitus, which can generally be made very perceptible by the surgeon giving a rotatory motion to the hand. The interosseous space may be still further diminished by compressing the bones. The forearm is generally semi-flexed, and there is but little shortening of the limb.

State of the parts.—The pronator quadratus muscle draws the under parts of the two bones towards each other, and the pronator radii teres draws the part of the radius into which it is inserted towards the ulna; this diminishes the transverse diameter, while the consequent pressing out of the muscles from between the bones occasions the increase of the antero-posterior.

Fig. 18.



The parts of the bones below the fracture can be made to point towards the parts above, only when the hand is in a straight line with the forearm, and midway between pronation and supination.

FRACTURE OF THE ULNA.

Three fractures of the ulna are met with, namely, of the shaft, and of the olecranon, and coronoid processes.

Fig. 18. From Liston.

Fractures of the processes present peculiar symptoms, and require particular methods of treatment; we shall, therefore, delay the consideration of them, until after the description of the treatment proper for the other fractures of the forearm.

FRACTURE OF THE SHAFT OF THE ULNA.

Causes.—This fracture is almost always caused by violence directly applied to the bone, as by a blow or a fall on the inner side of the forearm.

Symptoms.—The existence of this fracture can be easily discovered, by drawing the finger along the inner part of the ulna, when, from the superficial situation of the bone, an irregularity caused by the fracture is perceptible. There is a depression at the seat of the fracture, and the part below it is too near the radius.

Crepitation is usually perceptible on moving the under part backwards and forwards; and sometimes the long axis of the hand is not in a line with the long axis of the forearm, but is drawn inwards.

State of the parts.—The fracture is generally in the under part of the bone, where it is most slender, and exposed to injury from its superficial situation. The position of the fractured parts is as follows:—the part above the fracture is preserved in its natural situation by its connexion with the humerus, whereas the part below is drawn towards the radius by the pronator quadratus.

IV. TREATMENT OF THE THREE CLASSES OF FRACTURES OF FOREARM.

The treatment of all these fractures consists of two parts; the procuring and maintaining coaptation. This is procured by bending the forearm at right angles to the arm, and placing the hand midway between pronation and supination; then using slight extension, if necessary, and pushing back the protruded muscles between the bones. To maintain coaptation, we must call in the aid of both attitude and mechanism.

Attitude.—In each class of fractures the forearm ought always to be at a right angle with the arm, that the muscles of the arm may be uniformly relaxed; and the hand ought always to be placed midway between pronation and supination, that is, with the thumb upwards and the little finger downwards. If this be neglected, the fractured portions will unite so as to form an angle with each other; and the consequence will be the loss of the power of supination, if the hand be kept in a state of pronation, and of the power of pronation, if it be supinated. The only variation of attitude in the different classes of fractures is in the relative position of the hand and the long axis of the forearm: in fractures of both bones the long axis of the hand should be in a line with the long axis of the forearm; in fractures of the radius, the hand should be depressed; and in fractures of the ulna slightly elevated.

The object aimed at in these peculiarities of position is to prevent the diminution of the interosseous space; which is accomplished, in fracture of both bones, by uniformly extending the muscles connected with the radius and ulna; in fracture of the radius, by extending the muscles attached to the outer side of the radius, and in fracture of the ulna by

the extension of those on the inner part of the bone; and these conditions of the muscles are produced by the above-described attitudes of the hand. The following directions exhibit at one view the attitudes to be observed:—

1. Bend the forearm at a *right angle* with the arm.
2. Keep the hand midway between pronation and supination.
3. In fractures of both bones, *keep the hand in a line with the long axis of the forearm.*
4. In fractures of the radius, *depress the hand.*
5. In fractures of the ulna, *raise the hand.*

Mechanism.—Various appliances have been used to preserve the parts at rest, and in apposition. Some surgeons use paste-board splints, softened in hot water, and then moulded to the forearm; some employ splints composed of several parallel pieces of wood secured together by a piece of linen or leather, while others make use of two wooden splints, slightly concave on one side and convex on the other. Baron Boyer recommends that a small oblong pad should be applied between the concave surface of each splint, and the forearm, in order more effectually to press in the muscles, and to preserve the interosseous space. But if the splints be applied closely, the pressure in the direction of the antero-posterior diameter will be sufficient; nor will any padding be requisite, except a little cotton to prevent the pressure from irritating the skin. In fracture of a single bone the splints should extend only to the wrist; but when both bones are broken, one of the splints should reach to the fingers, that the hand may be kept in a line with the long axis of the forearm;—the longer is usually applied to the front of the forearm.

To preserve the mechanism in its proper situation various means have been employed. The common roller and starch-bandage are both objectionable, inasmuch as they tend, by pressing the radius and ulna together, to diminish the interosseous space; besides which they keep up a degree of heat about the part, and create trouble in taking off the splints, which must occasionally be done to ascertain whether the part presents the desired appearance. The loop-bandage is not liable to the same objections, but the most convenient and elegant manner of treating these fractures is to use the wooden splints, retaining them in the proper position by the buckle-bandage. Two or three may be used, and the forearm should be kept in a sling.

DIRECTIONS AS TO MECHANISM.

1. In fractures of one bone, apply two splints of equal length, not extending beyond the wrist.
2. In fractures of both bones, use two splints of unequal length, the larger being applied to the front of the forearm, and reaching to the ends of the finger; the other need not be extended beyond the wrist.

The objects aimed at by treatment in these fractures are to obtain coaptation, to preserve the interosseous space, and to keep the parts at rest in a proper position. For the attainment of these ends, attitude and mechanism are both necessary; the former should be used from the very beginning of treatment; but the application of mechanism should

be delayed until either the danger of inflammation supervening is over, or the inflammation, if it has already taken place, has been subdued.

[Dr. J. R. Barton, of this city, has called the attention of the profession to the treatment of fractures at the lower end of the radius.

Two splints are recommended, which should reach beyond the ends of the fingers. But previously to this application, one compress should be adjusted upon the lower fragment, and another against the lower extremity of the upper fragment.

Owing to the proximity of this fracture to the wrist, it is found that the stiffness of the joint is very great; and that notwithstanding the surgeon's efforts at passive motion, considerable inconvenience frequently results. Dr. Henry Bond, of Philadelphia, has recently read a paper before the College of Physicians, giving an account of a new splint for this fracture.¹

He objects to the present mode of treatment of this fracture, on the grounds that the muscles are rendered tense, and that, in order to prevent derangement of the fragments, the hand must necessarily be tightly bandaged in a constrained position, and that pressure on the bursæ of the tendons of the fingers must increase the danger of that protracted or permanent rigidity that often renders the hand and fingers unsightly, inconvenient, or useless.

"The muscles that act on the hand are least tense, or most in repose, when the hand is inclined backwards, so that the metacarpe forms a considerable angle with the forearm,² when it is also inclined inwards towards the ulnar side of the arm, and when the fingers are moderately flexed. In this case, it will be perceived that the longitudinal axis of the forearm, if prolonged, would not correspond with that of the hand, but would pass through, or very near, the point where the thumb and index finger most easily and naturally meet. Thus, in the innumerable manipulations with the thumb and fingers (as with a pen, pencil, button, needle, money, &c., &c.), their points most easily and naturally meet in this axis of the forearm. This will be found to be the position of the hand, when it hangs by the side with all the muscles relaxed.

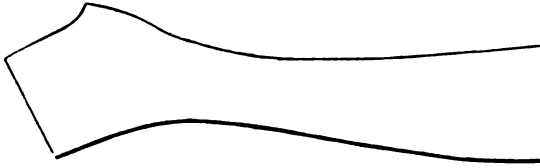
"But if the hand can be placed and retained in the unconstrained natural position above mentioned (to say nothing of the better chance of escaping permanent stiffness), in the first place, the unsightly deformity will be avoided; and in the next place, the hand will not entirely have lost its uses. For the hand, thumb, and fingers being placed very nearly in the position of their most frequent uses, the interossei, the lumbricales, and the several short muscles of the thumb will, by causing only a very limited motion, enable the hand to perform very many of its useful functions."

In order to fulfil these indications, Dr. Bond has devised a splint and dressing. A splint is cut out of a light thin board, of the shape of that represented in Fig. 19. The particular size and form can be obtained from the profile of the sound forearm and hand, when placed in its natural situation, the hand inclining towards the ulna. The lower end

¹ Trans. Coll. Physicians, Jan., 1852.

² Malgaigne calls this, "*la flexion habituelle de la main en arrière*."

Fig. 19.

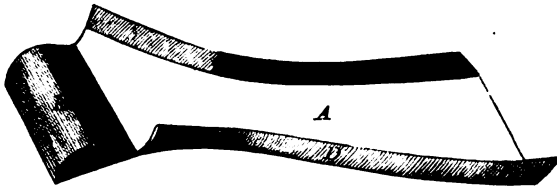


of the splint should be cut obliquely and reach to the second joint of the fingers, so as to allow them to be flexed.

This splint is then to be carefully covered with muslin or sheeting, which is to be fastened by tacks or glue, so that the roller can subsequently be applied with little danger of its slipping, and if necessary pins may be used to prevent its derangement.

A carved and rounded block (B, Fig. 20) is nailed or screwed to the extremity of the palmar surface of the splint, of such a size and form as to retain the hand in its habitual inclination backwards, and to give the fingers

Fig. 20.



that moderate flexure which most relieves the muscles from tension ; and also that position, which, if stiffness should result, will not only save the hand from a most inconvenient and ungraceful deformity, but will reserve to it the power of performing very many of its most frequent and useful functions.

A piece of binders' board, wider than the splint, is to be tacked to its palmar surface, and the projecting edges (D, Fig. 20) bent up so as to form a kind of box for the lodgment of the arm. The pasteboard is not an essential part of the splint, but may contribute to the comfort of the patient. The splint is then to be lined with flannel, which should also cover the block.

Two compresses, of the proper form and material, constitute the remainder of the dressing, unless the fracture be far above the wrist, and then a dorsal splint may be necessary to preserve the interosseous space.—ED.]

FRACTURE OF THE OLECRANON PROCESS.

Causes.—This, which is by no means an uncommon fracture, is usually caused by a blow or a fall upon the elbow, and sometimes, although very rarely, by violent contraction of the triceps extensor cubiti muscle.

Varieties.—This fracture may be, in direction, either transverse or oblique, and in situation, at the base, middle, or apex of the process. Transverse fracture in the middle of the process is the most frequent, both as to situation and direction.

Symptoms.—An unnatural hard swelling, caused by the olecranon, in the under and back part of the humerus, sometimes half an inch above the joint, and sometimes two inches from the part from which it is broken off; the distance is increased by bending the forearm, or by a voluntary effort on the part of the patient to accomplish extension of the joint. This swelling can easily be moved from side to side, but it cannot be pressed downwards without difficulty, especially if the extremity be in such a position as to keep the triceps on the stretch.

Bulging of the triceps above the hard tumour is a good diagnostic symptom.

An interspace on the back part of the joint between the olecranon, and the extremity of the ulna; this space is increased by a voluntary

Fig. 21.



effort on the part of the patient to extend the elbow, which merely draws up the broken fragment; or by the surgeon taking hold of the forearm and bending it, and it is diminished by extending the forearm. The surgeon, on pressing his finger into the interspace, feels as if it were sinking into the joint.

Loss of the power of extending the limb is another symptom; and the voluntary effort to do so causes pain, and merely draws up the olecranon. In some cases the power of extension is not entirely lost. This can only happen when the expansion of the triceps is not so completely destroyed as to disconnect the process from the rest of the bone. Sir James Earle has recorded a case in which the loss of extension did not take place until the sixth day, when it was sudden, and attended with sudden flexion of the forearm.

Crepitus may be discerned, if the extremity be very violently extended, and the parts pressed together with considerable force; but attempts to do this occasion great pain.

The forearm is usually half bent, and there is often great swelling about the joint, from increased secretion of synovia, and frequently ecchymosis to a considerable extent; but these last two symptoms will vary according to the degree of violence by which the accident was occasioned.

Mode of union.—Reunion in this fracture is almost always by a ligamentous substance, the length of which will vary according to the distance of the broken parts from each other. It is very desirable to

Fig. 21. From Liston.

have it as short as possible, because, in proportion to its length, the arm will be weakened. When the interspace is short, the ligamentous substance is firm, strong, and short; but if it be long, there may be openings through it, so that the reunion will be kept up by ligamentous cords. On account of the difficulty of preserving the parts in apposition, no other than a ligamentous union is generally to be expected. In some cases, however, when the fracture had happened very near to the shaft of the ulna, Sir Astley Cooper has known the union take place in the living subject by bone; but it is so rare an occurrence that it is scarcely to be hoped for. It seems evident from the following experiments, made by Sir Astley Cooper, that the difficulty of preserving the parts in apposition, is the obstacle to osseous union. "The integuments having been drawn laterally and firmly over the end of the olecranon in a dog, I made a small incision, and placed a knife, on the middle of that process, in a transverse direction; on striking it with a mallet, the bone was readily cut through, a separation directly took place by the action of the triceps muscle, adhesive matter was effused, and, when I examined the limb about a month after, I found the bone united by a strong ligament. I broke the olecranon in the same way in several rabbits; blood was, in these experiments, first thrown out, and then adhesive matter filled up the space of separation, which subsequently became ligamentous, and gradually firmer and firmer, as the time was protracted between the experiment and the time of the examination. As I found the ligament was formed in each of these experiments, I was anxious to learn whether the olecranon could be made to unite by bone, if a longitudinal fracture were produced with but slight obliquity, so that the broken portions might still remain in contact; and I found that, under these circumstances, the osseous union speedily took place. Therefore this bone, like the extremity of the os calcis, when it is broken off, is detached by the action of the muscles, and ligamentous union ensues from want of adaptation."

Treatment.—The principal indications in the treatment are—

First, If there be much inflammation and irritation at first, to delay all mechanical applications, until they are subdued by leeches, evaporating lotions, purgatives, and other remedies, which should be employed with activity proportioned to the violence of the symptoms.

Secondly, To maintain the fractured surfaces as close together as possible by the judicious position of the limb, and the absolute inaction of the triceps muscle aided by mechanical appliances.

The extremity must be kept very much extended, and for some time this can best be done by keeping the patient in bed. It is necessary not only to keep the forearm extended, but also to bring back the arm, that the shaft of the ulna may be brought as near as possible to the attachments of the triceps, both to the humerus and scapula, so that the least obstacle may be offered by that muscle to the bringing down of the olecranon.

Sir Astley Cooper recommends that the parts be kept in apposition, by placing tape or slips of linen longitudinally on each side of the joint, and applying over these a roller round the arm, immediately above and below the fracture only, and then tying the ends of the slips above the fracture to those below, so that the rollers, under which they pass, are

brought nearer to each other, and the detached fragments may be thus kept in the desired position.

Thirdly, to preserve the joint at perfect rest; and for that purpose a straight splint should be applied in front, and retained by a suitable bandage.

Fourthly, To begin passive motion of the joint in the course of a month, and for this purpose the splint is to be removed; but as there is great danger of weakening and lengthening the newly-formed bond of union, all attempts at motion must be made with the greatest care.

The above plan of treatment, in which the extended position and straight splint are employed, is that which is recommended by Sir Astley Cooper, and practised by most British surgeons; but it is objected to by Desault, Camper, and others, who recommend that the forearm should be kept midway between semiflexion and complete extension, and that this position should be preserved by means of an angular splint.

Desault and Camper, the advocates of this method, give the following reasons for preferring it to that usually practised by British surgeons.

1st. The method which they recommend will bring the fractured parts more in a line with each other. The brachialis anticus, in its way from the sides of the deltoid impression to the coronoid process, passes over the eminence formed by the lower extremity of the humerus; and they say that the muscle, being put violently on the stretch, will draw forward the ulna, if the olecranon be fractured near its base, and, consequently, the ulna and the broken fragment will not be in a line with each other, the shaft of the bone being brought too far forward. This objection does not apply to the method recommended by the French.

2dly. They also state that in the attitude recommended by the British surgeons, the broken parts can only be made to touch each other posteriorly, so that they form a retiring angle opening into the joint, into which, therefore, the substance effused for uniting the fractured portions will be thrown, and thus the future movements of the joint be permanently impeded; whereas, in the attitude of Desault, the two portions will meet in front, and form a retiring angle directed backwards, and thus the future movements of the joint will be unaffected by the new formation.

FRACTURE OF THE CORONOID PROCESS.

Causes.—This is a rare accident, but two cases are recorded by Sir Astley Cooper, and one by Mr. Liston. Of the two instances recorded by Sir Astley, one was the case of a gentleman, who fell on his hand while the arm was extended. The coronoid process, being driven against the humerus, received the shock, and gave way. The other instance was found in a subject brought to the dissecting-room at St. Thomas's Hospital, and the cause was unknown. The case mentioned by Mr. Liston, was that of a boy eight years of age, and the fracture was occasioned by his hanging for a long time by his hands, from the top of a high wall, being afraid to drop down.

Symptoms.—The forearm is extended, and the ulna projects backwards; but when the forearm is bent and brought forward, which is easily done, the deformity disappears; the limb, however, again becomes extended, and the deformity returns, when the force employed to bend

and bring forward the part is removed. The isolated process is felt in front of the joint, or higher up, according to the state of contraction of the brachialis muscle inserted into it.

Treatment.—The objects to be aimed at by treatment are,—to relax the brachialis anticus muscle, to preserve the parts at rest, and to keep the isolated fragment as much as possible in apposition with the part from which it has been detached. These objects may be best attained, by keeping the forearm very much bent, and applying angular wooden splints, very well padded, or pasteboard splints moistened in hot water, and moulded to the elbow.

This treatment should be continued for about a month, and passive motion should then be employed; but this must be done with the greatest caution, lest the ligamentous substance, which reunites the parts, should become weakened and lengthened.

FRACTURES OF THE HUMERUS.

These injuries, according to Mr. Lonsdale, form about one-sixteenth of all fractures, so that they occur less frequently than the corresponding injuries of some of the other bones. Of one hundred and eighteen cases of fracture of the humerus, mentioned by Mr. Lonsdale, eighty-nine were of the shaft, sixteen of the condyles, and thirteen of the surgical neck.

That the description of the different fractures of this bone may be more distinct, it will be convenient to arrange them in the following classes :—

1. Transverse fracture of both condyles.
2. Oblique fracture of either condyle.
3. Fracture of the under third of the shaft.
4. Fracture at the middle of the humerus.
5. Fracture below the insertions of the three muscles into the margins of the bicipital groove.
6. Fracture above the insertions of the three muscles into the margins of the bicipital groove, or, as it is called, fracture of the surgical neck of the humerus, a name given to all that part between the insertions of these three muscles and the tuberosities.
7. Fracture of the anatomical neck of the bone.

The bone may be broken in any part of its length, but all its fractures may be included in one or other of the above-named classes.

I. TRANSVERSE FRACTURE OF BOTH CONDYLES.

Symptoms.—The symptoms of this fracture are, an unnatural prominence behind the joint; immediately above this, an unnatural foss or depression; and preternatural shortening of the front of the forearm. These three symptoms are common to this fracture and dislocation backwards of the radius and ulna; but there is in fracture, the following sure diagnostic guide; if the arm be fixed, and the forearm be drawn in the line of displacement, the symptoms disappear; but they return, as soon as the extending force is removed. If the arm be fixed, and the forearm pressed backwards and forwards, or if it be rotated, crepitation may be perceived; and, if the arm be raised, and the forearm forcibly depressed, an angular deformity will be observed.

Desault and others mention frequent cases of this fracture, in which the condyles were not only broken off by a transverse fracture from the rest of the humerus, but also separated from each other by a vertical fissure. In these instances, we have in addition to the before-named symptoms, a still greater mobility of the parts, increased deformity, the bulging out of the joint laterally augmented by pressing in the direction of the longitudinal fissure.

State of the fractured portions.—In simple transverse fracture, the condyles are drawn backwards; in transverse fracture of both condyles with a longitudinal fissure between them, they are drawn backwards, and very slightly separated from each other. In this latter case the humerus is separated into three pieces.

Treatment.—Bend the forearm at a right angle to the arm, draw it forward until the parts be brought forward into their proper places and into apposition, and preserve them in this condition by applying a few turns of a roller round the lower part of the arm and the upper part of the forearm, and by employing two wooden splints,—one, straight, to be placed in front of the humerus, the other composed of two parts at a right angle with each other, the upper part to be placed behind the humerus, and the lower part below the forearm; both splints to be retained by buckle bandages. Evaporating lotions should be applied, and the extremity kept in a sling.

The above is the treatment recommended by Sir Astley Cooper; it should be continued in the case of an adult for about a month, and with a younger patient for nearly three weeks, after which time passive motion should be tried, that the joint may recover its power of moving.

I have treated this fracture very successfully by means of Weiss's splint, which is a most convenient apparatus for the purpose, inasmuch as it admits of the elbow being slightly moved when that is thought to be judicious, without the necessity of taking off the splint.

Desault has recommended two angular splints with joints, and some Italian surgeons apply two angular splints, the one before and the other behind the joint. If the condyles be separated, care must be taken to keep up lateral pressure.

Although in some instances this injury is so seriously complicated with laceration and contusion as to make it necessary to remove the limb, yet, from the small size of the joint and the accessible situation of all the parts with regard to surgical treatment, it is—except in cases of extreme complication and disorganization—comparatively safe in its results, and amputation is unnecessary.

II. OBLIQUE FRACTURE OF EITHER CONDYLE.

Before describing this fracture of the condyles, it may be proper to state, that modern anatomists have named the articulatory surfaces at the lower part of the humerus, the trochlea, and condyle, the former being the inner, the latter the outer articulatory surface, whilst the prominences beyond, or the eminences of attachment for the muscles, are named the epicondyle and the epitrochlea. The old nomenclature, however, is that followed by surgeons, namely, external and internal condyle, each condyle furnishing an articulatory surface and an eminence of attachment for muscles.

Fracture of either condyle may be either slight, as when the eminence of attachment only is broken off; or extensive, as when the articulatory surface is detached.

FRACTURE OF THE INTERNAL CONDYLE.

Symptoms.—When the fracture detaches but a small portion, the symptoms are a slight unnatural prominence, with crepitation and mobility, perceptible on grasping the part and bending the fore-arm backwards and forwards.

When the fracture is extensive, the forearm is bent, and the hand drawn a little inwards, and inclined to pronation; when the forearm is extended, the broken condyle projects backwards, and with it the ulna, occasioning the appearance of dislocation of the ulna, which, however, resumes its natural position when the forearm is bent. Additional symptoms are, mobility, crepitus, and pain on grasping the condyles and bending and extending the forearm; and slight projection forward of the condyle in front of the ulna, if it be very violently extended.

The nature of the displacement must be evident from what has been already stated.

FRACTURE OF THE EXTERNAL CONDYLE.

Symptoms.—When the fracture is slight, the symptoms are,—some degree of swelling about the external condyle, attended with pain; crepitation and mobility, perceptible on grasping the condyles and performing pronation and supination of the hand.

When the fracture is extensive, in addition to the above symptoms, the condyle is a little drawn backwards, and the radius with it; the forearm is slightly bent; and the hand is drawn outwards and inclined to supination.

Treatment of slight and extensive fracture of each condyle.

1. In both fractures of each condyle, preserve the forearm at a right angle with the arm.
2. In extensive fracture of each condyle, apply a few turns of a roller round the joint, and then a wooden splint, the parts of which are at a right angle with each other, placing one part behind the humerus and the other below the forearm, and retain it by buckle bandages.
3. In slight fractures of each condyle mould pasteboard splints to the joint, and retain them by a few turns of a roller or buckle bandages.
4. In both fractures of the internal condyle pronate the hand and bend the fingers.
5. In both fractures of the external condyle supinate the hand and extend the fingers.

III. FRACTURE OF THE UNDER THIRD OF THE SHAFT OF THE HUMERUS.

Symptoms.—Fracture in this situation is easily detected by inability on the part of the patient to raise the arm; by unnatural mobility at a part, which in the sound state is inflexible; by angular deformity on taking hold of the upper part of the humerus, and raising the arm;

and by crepitation on grasping the bone above and below the fracture, and moving the parts on each other.

Relation of the fractured portions.—In this situation there is little or no tendency to displacement, the parts above and below the fracture being equally embraced by the triceps behind and the brachialis anticus before. In fact, there is no tendency to displacement backwards, forwards, or to either side, and seldom any in a longitudinal direction, unless the fracture be very oblique, when, as the resistance offered by the bone to the contraction of the muscles is removed, there is a tendency to shortening of the arm.

Treatment.—This fracture is treated by applying two wooden splints, the one before, the other behind the humerus, and retaining them by means of buckle bandages, at the same time keeping the extremity in a sling, which should not be so short as to press up the elbow, but merely to support the weight of the limb. If the elbow should be pressed up by the sling being too short, and if the fracture should be oblique, the pressing of the fractured parts against each other may cause a shortening of the arm.

IV. FRACTURE OF THE MIDDLE OF THE HUMERUS.

Symptoms.—The same as in the preceding injury.

Nature of Displacement.—The displacement is rather more than in the fracture of the under third, the part below the fracture having a tendency to be drawn a little outwards.

Treatment.—The same as in the preceding injury, except that the splints should be applied to the outer and inner sides of the arm. Some surgeons employ four splints in this fracture, one to the outside, one to the inside, one to the back, and one to the front of the arm.

V. FRACTURE BELOW THE INSERTIONS OF THE THREE MUSCLES AND ABOVE THE INSERTION OF THE DELTOID.

Symptoms.—In addition to the symptoms exhibited by the two preceding injuries—mobility at a part naturally inflexible, inability to raise the extremity, crepitation, and angular deformity on raising the upper part of the humerus—this fracture has two symptoms peculiar to itself, namely, an unnatural swelling on the outside of the arm below, and another on the inner side above the fracture. These swellings are explained by the nature of the displacement.

Nature of Displacement.—The muscles which cause displacement are four, namely, three inserted into the margins of the bicipital groove, the pectoralis major, latissimus dorsi, and teres major, which draw the upper part inwards, and the deltoid inserted below the fracture, which draws the lower part outwards, and, if the fracture be oblique, upwards:—in this case there will be slight shortening of the forearm in addition to the other symptoms.

Treatment.—The first object of treatment is to obtain coaptation, which is easily effected by extension and counter-extension; then to preserve the extremity in the proper attitude, that is, with the arm by the side and the forearm at a right angle with the arm; and to keep the parts at rest and in apposition. Desault's apparatus for preserving

the extremity at rest in the proper attitude, and maintaining apposition, consists of two long rollers—a wedge-shaped pad which will extend the whole length of the arm,—three splints, two of which should be the length of the humerus, the third shorter, and a sling, not too short, otherwise it will, especially if the fracture be oblique, produce displacement of the fractured portions by raising the elbow and forearm too high.

Method of application.—Desault's directions are the following. Having damped one of the rollers with a little lead lotion to prevent its slipping, apply two or three turns round the forearm, then along the whole of the arm as far as the axilla, lapping the edges well over in order to keep up equable pressure; then take one or two turns of the roller under the axilla of the opposite side; place the short splint on the front, one of the long splints on the back of the arm, and the other long one on the outer part; taking care that the latter two extend along the whole length of the arm; and secure the three splints in their respective places by bandaging the arm from the top downwards with the same roller, finishing on the forearm where it commenced. The wedge-shaped pad should then be placed between the arm and the thorax, having its base upwards in the axilla, that it may prevent the three muscles from drawing inwards the part above the fracture; and then the second roller should be applied round the arm and chest to bandage them together, especial care be taken to apply it loosely above the fracture, that it may not press inwards the upper fragment; but very firmly below, that it may prevent the lower portion from being drawn outwards. The forearm should then be supported by a sling, which, however, must not be so short as to press the elbow too much upwards. The above, which is Desault's treatment, answers very well, and is generally preferred. A simpler plan, which is also found to be successful, is, after obtaining coaptation and placing the extremity in the proper position, to apply four splints, one to the inner side, one to the outer, one to the front, and one to the back of the arm, and to retain them by means of buckle bandages; then, after placing between the arm and chest a pyramidal pad with its base upwards, to bandage the arm and chest together, being careful, as in the other method, to make the bandage loose above and tight below the fracture; and, lastly, to support the forearm by a sling, which must not be too short, for the reasons before stated.

VI. FRACTURE ABOVE THE INSERTIONS OF THE THREE MUSCLES INTO THE BICIPITAL GROOVE, AND BELOW THE TUBEROSITIES; OR, AS IT IS OFTEN CALLED, FRACTURE OF THE SURGICAL NECK.

Symptoms.—The symptoms differ from those of the last-described injury only in this, that the unnatural swelling on the outside of the arm is above the fracture, and that on the inner side below it.

Nature of Displacement.—This is the very opposite of what is observed in the former injury; the part above the fracture is drawn outwards by the three muscles inserted into the greater tuberosity, namely, the supra spinatus, the infra spinatus, and the teres minor; and the part below is drawn inwards by the three muscles inserted into the

borders of the bicipital groove, namely, the pectoralis major, the latissimus dorsi, and the teres major.

Treatment.—The treatment differs from that of the former fracture in only two respects:—the apex of the pyramidal pad should be upwards; and the roller which is put round the arm and chest to bandage them together, should be applied loosely below the fracture, that the lower fragment may not be drawn inwards, and very firmly above, to prevent the upper fragment from being drawn outwards.

VII. FRACTURE OF THE ANATOMICAL NECK, OR BETWEEN THE BALL AND TUBEROSITIES.

The possibility of fracture in this situation is no longer a matter of doubt. Bichat saw, in the possession of Larbaud, the humerus of a young man, seventeen years of age, the ball of which was broken off from the rest of the bone. Delpech records an instance proved by dissection. Professor Samuel Cooper refers to the case of a boy shown to him with a fracture of the neck, and Sir Astley Cooper's work contains several interesting cases. I have in my museum an interesting specimen of this comparatively rare fracture.

The injury is almost always caused by direct violence. It is most frequently met with in youth, sometimes in old age, but very rarely in the middle period of life. Sir Astley Cooper's work contains the description of a case in an old person, where the existence of the fracture was proved by dissection.

Symptoms.—Acute pain is experienced, and sometimes at the moment of the accident a sound is heard as of something breaking. There is sudden inability to move the limb, which lies powerless by the side, though it yields in the freest manner to any motion communicated to it. When the limb is moved, crepitation is generally very perceptible, but every movement creates great pain. On examining the shoulder near the outer part of the coracoid process, a projection of bone is usually felt, which disappears on extending the arm, but returns when the extending force is removed; and immediately below the acromion process it is observed that there is no vacuity, in consequence of the ball remaining in the glenoid cavity. This is a diagnostic symptom between fracture of the neck of the humerus and dislocation of the shoulder. There may be a flatness of the arm on the outer side farther down, occasioned by the drawing in of a part of the deltoid by the upper extremity of the portion of bone below the fracture. If there be not very great swelling, it may be possible to feel the ball motionless in rotating the arm.

Fig. 22.



Fig. 22. United fracture of anatomical neck of Humerus. From a preparation in my museum.

Nature of Displacement.—The ball remains in the glenoid cavity, and the shaft is drawn forwards and upwards to the front and outer side of the coracoid process.

Treatment.—On this subject Sir Astley Cooper says, “The best mode of treating these accidents consists, in the young, in applying a splint on the fore and back part of the arm, binding it on by a roller, placing a pad in the axilla, and using a clavicular bandage, supporting the hand, but not the elbow, in a sling, since, if the elbow be raised, the broken end of the bone is pressed forwards. In old persons the injury is more severe, and the force producing it is violent; it therefore becomes necessary to reduce inflammation, and to apply leeches and evaporating lotions, to observe perfect rest at first, and after some time the same treatment as to bandages may be pursued as in the young. In both the old and the young, passive motion is to be employed so soon as the union is effected, which in youth is in a month, but it requires from two months to twenty weeks in old age. In all fractures about the upper part of the arm and shoulder, it is judicious to support the vessels of the hand and forearm by a bandage. If this precaution be neglected, the pressure on the axillary and cephalic veins will be apt to produce engorgement of the more distant parts, for the removal of which it is sometimes necessary to take off for a time all retentive apparatus, and to confine the patient to the recumbent posture.”

FRACTURE OF THE SCAPULA.

The comparative frequency of fractures of the scapula is thus stated by Mr. Lonsdale. Out of one thousand nine hundred and one cases of fractures generally, eighteen were of the scapula, and of these eight were of the acromion process, eight of the body, and two of the cervix.

Fractures of the scapula may be divided into five classes:—fractures of the acromion process—of the inferior angle—of the body—of the coracoid process—and of the cervix.

The first two classes are of most frequent occurrence. The body of the bone from its depth, covered position, and mobility, is by no means very liable to fracture, and the coracoid process and cervix are very seldom broken; hence Boyer remarks, they generally require great violence to break them, and then the contusion of the soft parts is a worse injury than the fracture; for example, he has seen the coracoid process broken by the blow of the pole of a carriage, and the patient lose his life by the violence inflicted on the soft parts about the shoulder.—(Mal. Chir. t. iii.)

FRACTURE OF THE ACROMION:

Symptoms.—The patient feels as if the shoulder were falling down, complains of a great sense of weight, and has little power to raise the arm. On tracing the spine from its base to the acromion process, it is observed that the part between the fracture and the clavicle is depressed, from being drawn down by the weight of the extremity, and the contraction of the deltoid muscle. The roundness of the shoulder is lost; the ball of the humerus falls as far down into the axilla as the capsular ligament will permit; and the measurement from the sternal end of the

clavicle to the extremity of the injured shoulder, compared with the sound side, will be found to be diminished. On placing one hand over the acromion, and pressing up and rotating the humerus with the other, crepitation will be perceptible. When the humerus is raised, the deformity of the shoulder disappears; but it returns when the arm is allowed to fall down.

Nature of Displacement.—The scapula and the remaining portion of the acromion are drawn upwards and a little backwards by the trapezius and levator scapulæ; while the fractured part is drawn downwards and a little forwards by the weight of the extremity and the deltoid muscle.

Treatment.—The objects to be attained in this case are,—

First, To raise up the broken fragment, and keep it in its proper position.

This can best be done by raising up the elbow, and keeping it raised by a short sling; the ball of the humerus is thus pressed up, and made to act as a splint in keeping the fractured parts in apposition.

Secondly, To relax the deltoid muscle.

This is best effected by placing a cushion between the elbow and the side.

Thirdly, To keep the arm at rest in rather a backward position.

This is easily done by bandaging it to the chest with a roller. And,

Fourthly, To exert some pressure over the acromion, by which close coaptation may be secured; and this may be effected by a few turns of the roller by which the arm is bandaged to the chest.

It is quite possible to treat this fracture in a satisfactory manner by means of a cushion and a single roller, the latter being applied so as to bandage the arm to the chest, to raise up the elbow, and also to exert pressure over the acromion. Mr. Liston proposes the same simple apparatus as he recommends in fracture of the clavicle, which shall be described in treating of the fractures of that bone.

FRACTURE OF THE INFERIOR ANGLE.

Symptoms.—In this injury the detached angle can for the most part be felt to be too far forwards; but the most diagnostic mark is, that it remains stationary, if motion be communicated to the scapula; or, if the angle be moved, the scapula is unaffected by that motion.

Nature of Displacement.—The body of the scapula remains in its natural situation, and the inferior angle is drawn forward,—a displacement caused, if the fracture be very near the angle, by the fibres of the serratus magnus; and if it be higher up, by the same fibres and the teres major and latissimus dorsi muscles.

Treatment.—The angle is too small to be easily kept back, and coaptation is attempted by bringing the scapula forwards and downwards, and by keeping it in that position. The arm is pressed downwards, forwards, and inwards, and in that situation bandaged to the chest, while by means of the roller by which the arm is secured, and one compress behind the body of the scapula for pressing it forwards, and another before the angle for keeping it backwards, the parts are maintained in apposition and at rest.

FRACTURE OF THE BODY OF THE SCAPULA.

Fig. 23.



The fractures in this situation may be either transverse or longitudinal; the latter, which is the less frequent, can generally be distinguished by crepitus, to which will be added, in transverse fractures, an irregularity of the posterior costa of the bone.

There is little tendency to displacement, because all the parts surrounding the fracture are embraced by muscles, both on the outer and inner aspects of the bone; and all that is necessary in the way of treatment is to keep the arm in a sling, and the scapula forward by a few turns of a roller round the chest. If the fracture be completely transverse, then the under parts will be drawn forwards, and the same treatment will be required as for fracture of the angle.

FRACTURE OF THE CORACOID PROCESS.

The distinctive characters of this injury are,—pain, which is increased by stretching back the arm, or by any voluntary effort to raise it; and mobility of the coracoid process when the scapula is rendered immovable. This unnatural mobility is very perceptible on fixing the scapula, and moving the arm backwards and forwards. When the arm hangs by the side, the apex of the coracoid process can be felt lower than on the sound side. The fracture is easily discoverable.

Nature of Displacement.—The scapula remains in its natural position, but the coracoid process is drawn downwards by the coraco-brachialis, and biceps muscles, and downwards and inwards by the pectoralis minor.

Treatment.—The great object is to relax the coraco-brachialis, biceps, and pectoralis minor muscle, so as not to keep up the displacement. For this purpose the forearm should be bent on the arm, and the arm placed across the chest, and the scapula pressed downwards and forwards; the parts being maintained in that position by bandages. Gentle compression by a pad placed below the coracoid process is also useful for keeping the fragment in a proper position. Another important part of treatment is to keep the patient for some time in bed, with the shoulders bent downwards and forwards by means of pillows.

There seems to be no reasonable prospect of osseous reunion. The new connexion is formed by a ligamentous substance.

Fig. 23. Union of fracture of body of Scapula. From a preparation in my museum.

FRACTURE OF THE NECK OF THE SCAPULA.

By this injury is not to be understood fracture of the anatomical neck of the scapula, which is situated beyond the glenoid cavity, and before the coracoid process, but fracture of what has been called the surgical neck; that is the narrow part of the bone, into the formation of a part of which the semilunar notch enters, and which is behind the root of the coracoid process.

In this fracture the glenoid cavity and the coracoid process are both broken off from the rest of the bone.

This is, comparatively, a very rare injury; so that some excellent authorities have doubted the possibility of its taking place as the result of direct violence; but its occurrence has now been proved by dissection. I have seen three examples of this fracture. One was in a woman upwards of forty-five years of age—another, in a man upwards of fifty—and a third, in a lad of sixteen. They were all caused by falls on the upper and back part of the shoulder. That in the case of the lad happened in consequence of falling over a deep embankment. The symptoms were exceedingly well marked, and all the patients became perfectly well: but in the case of the female not until the lapse of four months.

Symptoms.—The signs of this injury are—flattening and falling down of the shoulder; an unnatural depression under the acromion, and an unnatural tumour in the axilla caused by the head of the humerus; symptoms which can all be made to disappear, by pressing up the arm, but which return as soon as the support to the arm is removed. The same appearances are presented in dislocation downwards of the humerus; but the fracture is easily distinguished by observing with what facility the arm can be raised, and the symptoms be made to disappear, and how immediately they return when the arm is left to itself. Besides these peculiarities, which are not found in dislocation, there is another symptom which clearly indicates fracture, namely, crepitation. Sir Astley Cooper remarks, that the best method of discovering the crepitus is, for the surgeon's hand to be placed on the top of the shoulder, and the point of the fore-finger to be rested on the coracoid process; the arm being then rotated, the crepitus is directly perceived, because the coracoid process being attached to the glenoid cavity, and being broken off with it, though it remains itself uninjured, the crepitus is communicated through the medium of that process.

Nature of Displacement.—The body of the bone remains in its natural posi-

Fig. 24.



tion, and the broken fragments is drawn downwards and inwards by the weight of the extremity.

Treatment.—In the treatment of this fracture, three things are to be done : first, the head of the humerus is to be kept outwards ; secondly, the glenoid cavity and the neck of the scapula are to be raised by elevating the humerus ; and thirdly, the parts are to be kept at rest. The appliances necessary for these purposes are,—a pad in the axilla for keeping out the head of the humerus ; a short sling for maintaining the arm in a raised position ; and a roller to preserve the parts at rest by bandaging the arm to the chest.

In the adult, the time required for recovery from this accident is about three months.

FRACTURE OF THE CLAVICLE.

As the clavicle is unprotected by soft parts, unsupported in its middle, is of considerable length in comparison with its thickness, and from its position between the scapula and sternum, has to sustain any shock received on the shoulder, or on the glenoid cavity of the scapula—as when a person falls on the hand with the arm extended—it is very liable to fracture. According to Mr. Lonsdale, of all fractures that occur in the vicinity of the Middlesex Hospital, one-seventh are fractures of the clavicle.

Causes.—This fracture may be occasioned by direct violence, as by a blow ; or by striking against a hard substance in a fall ; or by indirect violence, or counter-stroke, as by a fall on the point of the shoulder, when the clavicle has to sustain the force of the shock, or by a fall on the elbow or hand, when the extremity is extended.

Situation of Fracture.—The fracture, if caused by directly concentrated force, may be at any part of the bone to which the force is applied ; but it may be stated as a general rule, that fractures take place most frequently in the middle of the bone, and in the scapular more frequently than in the sternal extremity. On this subject Mr. T. Wilkinson, King's Lecturer on Comparative Anatomy and Physiology at Guy's Hospital, remarks :—"I have under my immediate observation twenty-two examples of broken clavicles repaired. Of these, fifteen have been divided close to the middle, or very slightly external to this point ; but two of the same have also been divided at about one inch from their outer extremities. Four other specimens have been broken transversely in the situations last named. The remaining three have been fractured about an inch from their sternal ends. One of the cases said to have been broken near the middle has had about three-fourths of an inch isolated by a double transverse fracture, which is also split longitudinally into two parts. The proportions stand thus :—

Clavicles broken	at the middle simply,	12
"	" at the middle twice,	1
"	" at the middle and outer end,	2
"	" at the outer end only,	4
"	" at the inner end only,	8

Thus it is very evident, that the strong cylindrical arch formed by the inner half of the collar-bone, is very little susceptible of fracture,

although much exposed to direct blows. As a general rule, it may be stated that fractures take place in large proportion towards the outer end of this arch, and but rarely near its middle. With respect to the outer half, fracture is still uncommon, and almost confined to a transverse division about one inch from the outer point.

For facilitating the description of fractures of the clavicle, it will be convenient to divide them into those on the scapular and those on the sternal side of the attachment of the coraco-clavicular ligaments to the outer tubercle of the bone.

FRACTURE ON THE SCAPULAR SIDE OF THE CORACO-CLAVICULAR LIGAMENTS.

Symptoms.—On very careful examination it will generally be found, that the part of the bone on the outer side of the fracture is drawn very slightly downwards. This symptom, never very perceptible in this fracture, can sometimes scarcely be discovered; but it will be made more obvious by pulling down the arm, and on pressing the arm upwards the fragment will be replaced, so as to be on a line with the rest of the clavicle. On placing one hand over the fracture, and with the other alternately elevating and depressing the shoulder, crepitus will be perceived. Sometimes the parts remain so nearly in their natural position, that the usual motions of the arm can still be performed.

Nature of Displacement.—There is very little displacement, the part on the outer side of the fracture being retained in its position by its attachment to the acromion process by the acromio-clavicular ligaments, and the part on the inner side by the coraco-clavicular ligaments. This connexion of the parts on each side of the fracture with the processes of the scapula, prevents any further displacement than a very slight depression of the outer fragment, occasioned by the weight of the extremity.

Treatment.—If there be no displacement, all that is necessary in the way of treatment is to preserve the parts at rest by keeping the extremity supported by a sling, and the arm bandaged to the side. If there be displacement, the same treatment answers as for the fracture next to be described, excepting that the pad in the axilla should be very small, the fragment not having the same tendency, as in the next case, to fall towards the chest.

FRACTURE ON THE STERNAL SIDE OF THE CORACO-CLAVICULAR LIGAMENTS.

Symptoms.—The broken clavicle being no longer able to sustain the weight of the extremity, or to keep off the scapula from the chest, the arm falls down, drawing with it the part on the scapular side of the fracture, and thus occasions an unnatural depression, which, together with the prominence caused by the sternal end remaining in its natural situation, clearly points out the nature of the injury. The scapula being no longer kept back by the broken clavicle, the shoulder and arm fall inwards and forwards, rendering the distance between the sternal end of the clavicle and the apex of the shoulder, less on the affected than on the sound side, and the arm is drawn forward towards the breast. By press-

ing the head of the humerus very forcibly upwards and outwards, the symptoms may be made to disappear, but they immediately return when the force is removed. The patient inclines the head and neck to the shoulder, and takes off the weight from the broken clavicle when standing, by supporting the elbow with the opposite hand; and when sitting, by resting the elbow on the knee. He is unable to raise the hand to his head in consequence of the humerus no longer having a fixed point of support. There is swelling from extravasated blood over the bone, and crepitation may be perceived by raising the arm and carrying it backwards so as to bring the fractured surfaces in contact; but attempts to discover this symptom occasion great pain.

Nature of Displacement.—The part on the sternal side of the fracture, though it appears to be drawn upwards from the falling down of the remaining portion, is in its natural situation, being retained there by the power of the sterno-cleido-mastoideus muscle above, and of the costo-clavicular ligament, and pectoralis major muscle below. The scapular portion is displaced in three directions, namely, downwards, inwards, and forwards; downwards, chiefly by the weight of the extremity, assisted perhaps by the contraction of the deltoid,—and inwards and forwards by the pectorales muscles, the broken clavicle being no longer able to keep the shoulder outwards and backwards. The scapular part of the clavicle is thus drawn under the sternal portion, so that the one part rests upon the other.

Treatment.—The parts are to be brought on a level with each other, and the fractured ends into apposition, and to be preserved in this situation. To effect this the outer portion of the bone must be raised upwards, and also drawn outwards and backwards; which may be done by pressing the humerus very forcibly upwards, and keeping it raised by a short sling; and then placing a thick pad beneath the axilla, drawing the arm backwards, and bandaging the elbow firmly to the trunk. The pad acts as a fulcrum, the humerus as a lever, and the bandage as the power; and thus the upper part of the humerus, and with it the scapula and the outer portion of the clavicle, are drawn outwards and backwards.

In the treatment of this fracture many different kinds of appliances have been used. At one time it was the practice of many, when the shoulders had been drawn back, and were held fixed in that position, to place one end of a roller in the axilla of the injured arm, then to apply the roller obliquely across the back over the shoulder of the opposite side, and afterwards to wind it through the axilla of that side, and from that obliquely upwards over the shoulder of the affected side, and having made this figure-of-8 turn secure, to make several other turns successively in the same manner. The shoulder having been thus bandaged back, the arm was placed in a sling. This is what was called the treatment by the figure-of-8 bandage. One objection to this treatment is, that the roller is apt to become roped, and to excoriate the edges of the axilla. To remedy this inconvenience, Brasdor suggested as an improvement, the bandage which bears his name. It consists of a back-piece of stout leather softly cushioned, with two well-padded straps attached to the sides, and a belt running along its lower margin to sur-

round the waist, and to fix the bandage in its proper position. One of the straps is passed under each axilla, and returns over the shoulder to be buckled to the upper part of the back-piece: the back-piece is divided down the middle, and the two portions are connected by a lace, in order that it may fit persons of various sizes.

The object of this appliance, is to draw back the shoulder; but this alone is insufficient. In treatment of fracture of the clavicle, three things are requisite:—to elevate the shoulder, to carry it out from the chest, and to throw it backwards so as to produce extension of the clavicle, and bring its overlapping ends into contact. With these views, and to effect these purposes, Desault constructed his bandage, which consists of two single-headed rollers, each nine yards in length, and a wedge-shaped pad for the axilla. The pad is placed in the axilla, and retained by two ribands attached to it, which are tied over the opposite shoulder; the elbow is brought forward, lifted up, and pressed inwards against the chest, thus making the humerus act as a lever upon the pad in the axilla, for the purpose of extending the fractured clavicle. The arm being supported in this position, with the elbow bent at a right angle, one of the rollers is carried round the chest and upper arm, being drawn more tightly as it approaches the elbow; a compress, dipped in camphorated spirits, is next laid upon the fractured bone, and the second roller, commencing in the opposite axilla, is carried across the chest, and over the compress and shoulder; then, passing down behind the arm and under the elbow, it is again taken across the chest, and over the sound shoulder to the axilla, where it commenced; and the same course is repeated till the roller terminates. The turns are secured by pins or stitches, and the hand is supported by a sling.

Brunninghausen recommended for the treatment of this fracture, a leather strap, put on like the figure-of-8 bandage, with two pads fixed upon it, to prevent excoriation of the axilla.

Of these four plans of treatment, the first two, together with Brunninghausen's, act on the same principle, namely, that of keeping back the shoulder; but they leave unfulfilled the other indications, which are no less important. They are also liable to the following objection:—if any of the three different appliances be drawn tight to fix the shoulder, the shoulder will be drawn towards the chest, and, in consequence, the fractured parts will not be in apposition. On the other hand, the method of treatment recommended by Desault, is scientific and excellent; but as his manner of bandaging is rather complicated, and in the case of females very inconvenient, it has never been very generally adopted in this country.

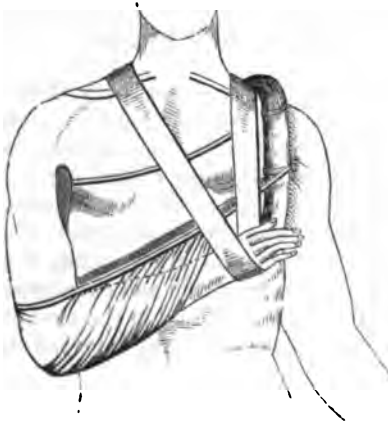
The following plan of treatment, recommended by my late friend, Mr. Liston, is simple, judicious, and unobjectionable. "When the patient is seen immediately after the accident, the bones are, without delay, and before inflammatory swelling has come on, to be placed in apposition and retained. No complicated apparatus is required. A pad, firm, though of soft material, and large enough to fill the armpit completely, is rolled in a shawl, and placed in the axilla; it is retained by tying the shawl over the opposite shoulder, a soft pad being interposed between the knot and the skin to prevent excoriation, and is further secured by

tying the ends under the axilla of the uninjured extremity, which should also be protected by a small cushion.

"A few turns of a roller, or a handkerchief, are placed round the arm and chest, so as to secure and fix the limb, and the retentive apparatus is completed. The shoulder is thus raised, and removed from its unnatural position, and the fractured extremities of the clavicle, previously placed in accurate contact, are prevented from being again displaced. The elbow and the forearm should be supported by a sling, otherwise the unsupported weight of the limb dragging on the shoulder will cause considerable pain, and subsequent displacement will be apt to occur. The apparatus should be looked to occasionally, adjusted and tightened; and the cushions should be replaced by fresh ones, to prevent excoriation and uneasiness. The bone will be found to be quite smooth, to remain of its proper length, to unite generally within twenty days, and that without any unseemly exuberance of callus. No compress or splinters need be applied over the bone; no evaporating lotions are necessary. If the patient be bruised in other parts, and become feverish, it may be requisite to abstract blood, and to exhibit antimonials, purgatives, &c. But all inflammation, arising from the fracture, subsides on the accomplishment of reduction, adaptation, and retention of the portions. If the fracture be compound, the edges of the wound should be brought together, and retained, so as to favour immediate union."

[The apparatus of Dr. Fox, of the Pennsylvania Hospital, is the one generally used in that Institution, and in this city. It is simple in its construction, easily applied, and fulfils all the indications. It consists

Fig. 25.



of a collar, pad, and sling. The *collar* is made of muslin, and is merely a stuffed ring encircling the sound shoulder, and its use is to afford a firm point of resistance, to which the other parts of the apparatus may be attached.

The *pad* is wedge-shaped, and should be sufficiently large at its upper extremity to act as a fulcrum when placed in the axilla, whilst the humerus is used as a lever. Broad tapes are attached to the two corners of the thick end of the pad; one tape is brought across the chest and tied to the collar, the other tape is brought across the back, and tied to the collar behind, and thus the pad is firmly secured in the axilla.

The sling is made of strong linen or muslin, sufficiently large to contain the forearm and elbow. Cords or tapes are fastened to the sling near the elbow and wrist. When the sling has been applied, it is to be secured by bringing the tape from the humeral portion of the sling across the back, and tying it to the collar. The tapes from the carpal corners of the sling are to be carried up in front of the chest,

and also fastened to the collar. By these means the shoulder can be drawn upwards, outwards, and backwards, and the fragments retained in coaptation.—Ed.]

FRACTURES OF THE THIGH-BONE.

FRACTURES OF THE NECK OF THE THIGH-BONE.

FRACTURES of the neck of the femur may take place in any point of its extent; and they often extend outwards through the trochanter major, but very seldom inwards, so as to traverse the articular surface. The articular surface presents a remarkable difference, as to its tendency to disease, and its liability to injury from fracture. It is very prone to disease; it is scarcely ever the subject of fracture.

Arrangement.—Fractures of the cervix femoris are divided into three classes:—

1st. Intra-capsular transverse fracture, so named from its being within the capsular ligament, and nearly forming a right angle with the long axis of the neck of the femur.

2d. Extra-capsular transverse fracture, when the fracture is without the capsular ligament, and the neck is broken off at its junction with the trochanter major.

3d. Oblique fracture of the neck, extending through the trochanter major. This fracture may be partly within, and partly without the capsular ligament.

INTRA-CAPSULAR TRANSVERSE FRACTURE.

Symptoms.—I. Shortening of the extremity of the affected side.

This symptom may be discovered by placing the patient straight on his back, and comparing accurately the two limbs, knees, and ankles; or by comparing the measurement, between a fixed point of the pelvis and one below the supposed fracture with the measurement between the corresponding point on the opposite side of the body. In the entire state of the bone, the muscles extending from the pelvis to the femur are kept somewhat on the stretch by the resistance which the neck and head of the bone offer to their contraction; but when the neck is fractured, the resistance is diminished, and the femur is consequently drawn up by the contraction of the muscles. When the patient is in the recumbent posture, the shortening is caused entirely by the action of the muscles; but in the erect position not only is the part external to the fracture drawn up by the muscles, but also the part of the neck internal to the fracture is pressed down by the weight of the body.

This symptom is usually less apparent immediately after the injury

Fig. 26.



than at a subsequent period, some time being required for the complete contraction of the muscles. As shortening is a symptom of some of the dislocations of the hip-joint, it is of the greatest importance for the purpose of diagnosis to attend to all the distinguishing peculiarities of the shortening from fracture. In addition to the peculiarity already stated, namely, that the shortening is not so apparent immediately after the injury, until the muscles have had time to contract, it may be remarked that for some time the injured limb may, by being drawn down, be easily made of the same length as the other, but it returns to its former position as soon as the extending force is discontinued. After a very considerable period, however, the muscles become so permanently

Fig. 27.



contracted, that they are capable of resisting a force which was previously sufficient to bring down the limb.

The degree of shortening varies much in different kinds of fracture. In intra-capsular fracture there is a difference of opinion on the subject among surgical authorities. Sir Astley Cooper states,¹ "The leg becomes from one to two inches shorter than the other, for the connexion of the trochanter major with the head of the bone by means of the cervix being destroyed by the fracture, the trochanter is drawn up by the muscles as high as the capsular ligament will permit, and consequently rests upon the edge of the acetabulum, and upon the ilium above it." The degree of shortening here specified is greater than has been found in the experience of Boyer, and some other continental authorities, or in that of Messrs. Liston, Stanley, Samuel Cooper, and R. W. Smith. Mr. Smith states as the result of his observation that the shortening in this fracture varies from a quarter of an inch to an inch, and in this opinion most surgical authorities now agree. Mr. Smith refers to fifteen examples of fracture of the neck of the femur in the Museum of Richmond Hospital, thirteen of which were taken from patients who died in the hospital, and

in each case the degree of shortening was carefully observed. In one instance only did it exceed an inch, and in that it was an inch and a half;

¹ New edition of Sir Astley Cooper's *Treatise on Dislocations and Fractures*, by Mr. Bransby B. Cooper, p. 149, Am. edition.

but the accident had happened some years previous to the measurement, and the neck of the bone had been absorbed. In two instances I had the opportunity of measuring the degree of shortening, and of verifying by dissection that the fractures were entirely within the capsular ligament. The one case was that of a woman, seventy years of age, and the shortening was three-quarters of an inch. Death took place two months after the accident, and on dissection the fracture was found to be within the capsular ligament, which did not appear to have been lacerated. The other case was that of a man, whose precise age could not be ascertained, but who appeared to be considerably above forty years: he met with this fracture, together with that of several ribs, and other serious injuries, by falling from the top of a house upon the pavement. The shortening equalled one inch. Death took place ten days after the accident; and on dissection it was found that the fracture was entirely within the capsular ligament, which in this instance was rather extensively lacerated, especially above. The extent of retraction seems to depend very much on the circumstance whether or not the capsular ligament over the neck of the bone be torn; for although, as Boyer remarks, it yields a little without being torn, yet if it remains entire, or nearly so,¹ retraction may be almost completely prevented. This was found to be the case by Smith, Stanley, and others, and Mr. Liston remarks with regard to the same point, "In fracture within the capsule, and where the fibrous envelope of the neck of the bone is not completely torn, there can be but slight displacement; and by the most attentive comparison of the two limbs, abbreviation of the one which has sustained the injury may not be detected."

Sabatier, Dupuytren, and others, have found in many cases that there was no shortening for many days after the injury, and that then it took place very suddenly on the patient making some exertion, or during some movement in the examination of the limb. This sudden shortening at a period remote from the injury is accounted for by Dupuytren on the supposition that the fracture is within the capsular ligament, and by reason of some irregularity in the fractured surfaces the one fragment is wedged into the other, or the displacement of the one prevented by the position of the other, but that during some movement of the limb, the relations of the fragments become so altered as to admit of retraction. Mr. Smith and others agree with Dupuytren in viewing it as a sign of the fracture being within the capsular ligament, but they attribute it to the ligament suddenly giving way at the moment of the rétraction.

II. *Eversion of the Foot and Knee* is a frequent, but not an invariable symptom of this fracture. There is great difference of opinion as to the cause of this symptom. Sir Astley Cooper considered, and most British surgeons agree with him, that it is occasioned by the rotator muscles. Bichat and Boyer thought that it is produced by the weight of the foot. Dupuytren ascribes it to the direction of the fracture, and the relations of the fractured portions to each other; and Mr. Liston says, "The position would appear to depend upon chance in a great measure, and upon the way in which the limb has bent under the patient, or has been placed on his being taken up. The position may be altered

¹ Louis has asserted that the displacement may be considerable, but he has not supported this assertion by facts or reasoning.

during the examination of the limb ; it may first be inverted, and afterwards, by the weight and inclination of the limb and foot, and the action of the powerful rotators outwards, the toes may become everted." In explanation of the more general outward direction of the toes, Sir Astley Cooper remarks,—“This state depends upon the numerous and strong external rotatory muscles of the hip-joint, which proceed from the pelvis to be inserted into the thigh-bone, and to which very feeble antagonists are provided ; thus, the obturators, the pyriformis, the gemini and quadratus, the pectinalis and triceps, all assist in rolling the thigh-bone outwards ; whilst only a part of the glutæus medius and minimus, and the tensor vaginæ femoris are the principal agents in rotation inwards. It has been denied that this eversion is caused by the muscles, and it has been attributed to the mere weight of the limb ; but any one may satisfy himself that it arises chiefly from the muscles, by feeling the resistance which is made to any attempt at rotation of the thigh inwards. This difficulty of rotation inwards is also in some measure attributable to the length of the cervix femoris, which remains attached to the trochanter major, because in proportion to its length which rests against the ilium, the trochanter is prevented from turning forwards.” In addition to the tensor vaginæ femoris and anterior parts of glutæus medius and minimus, the two ischio-tibial muscles, namely, the semi-tendinosus and semi-membranosus muscles should be enumerated as rotators inwards. When the foot is advanced, they prevent the heel from being so much turned inwards as to obstruct the other foot ; but since they are more relaxed than usual by the shortening of the extremity, they can in this fracture have no effect in counteracting the powerful rotators outwards. Eversion does not take place to its full extent for some hours, as the contraction of the muscles is gradual.

Bichat and Boyer, as it has been already stated, attributed the eversion to the weight of the foot, and thought that if it were caused by muscular contraction, there would be more difficulty in turning the foot inwards. Bichat also objected, that if the eversion were occasioned by the action of the rotators outwards, this position of the foot would be invariably met with, which is not the case ; an objection which applies as strongly to his own explanation as to that which he rejects ; and he further states, that in consequence of the fracture, the external rotator muscles, going from the pelvis to the part of the thigh-bone beyond the fracture, have, with the exception of the quadratus femoris, their extremities approximated, and are, consequently in a state of relaxation. In answer to this it has been stated that the general influence of the muscles is to draw up the trochanter, and thus to operate against the relaxation of the rotators, and even to augment their influence.

Baron Dupuytren suggests that the position of the foot may depend on the direction of the fracture, and the relative situation of the fragments : that if the outer fragment be in front of the inner, the foot will be turned outwards, but if the outer be behind the inner fragment, the foot will be inverted.

Although eversion is the usual position of the foot in fracture of the neck of the thigh-bone, it is necessary to remember that inversion is occasionally found. The following case, recorded by Mr. Stanley, is a striking instance of this, while it also shows the importance of correct

diagnosis :—"A middle-aged man fell in the street, and his hip struck the curb-stone. The immediate consequences were, that the limb was inverted and shortened to the extent of an inch, and no crepitus could be discovered. It was presumed that a dislocation had occurred, and accordingly an extension of the limb was made, and so great was the constitutional irritation occasioned by the repeated trials to reduce the supposed dislocation, that the man died about five months from the time of the accident. In the dissection of the hip, a fracture was found, extending obliquely through the neck of the femur, *but entirely within the capsule*. A portion of fibrous and synovial membrane on the anterior side of the neck of the bone had escaped laceration." The surgical authorities of this country record many cases of inversion, in addition to the above-mentioned example given by Mr. Stanley. Sir Astley Cooper, at page 158 of his work on Dislocations, mentions the case of Mrs. Whateley, sixty years of age, in which the toes were turned inwards, and on dissection the fracture was found within the capsular ligament. Mr. Guthrie, in an interesting paper in the Med. Chir. Trans. vol. xiii., refers to a case of Mr. Langstaff's, in which there was inversion, and on dissection there was a diagonal fracture through the trochanter major. He also mentions a case in which the limb, having been in the first instance everted, suddenly turned inwards when the patient began to use it. Some French authorities refer to inversion in fractures of the neck of the femur as a more frequent symptom than it is admitted to be by surgeons of this country. Paré and Petit describe the derangement inwards, as they call it, of the foot, as having taken place in all the cases of this kind which came under their notice. Desault concluded from his

Fig. 28.



Fig. 28. Case of fracture of Cervix Femoris, accompanied with much shortening of the limb, but unattended with either inversion or eversion. From a patient in my wards in the Royal Infirmary.

experience that the cases of rotatory derangement inward were to those outward in the proportion of 1 : 4.

As to the occasional occurrence of inversion, there is now no doubt, but much difference of opinion exists as to its cause. Some have supposed that the capsular ligament remaining entire in the front of the joint, and retaining an attachment to the bone beyond the fracture, might cause inversion ; but although this condition might possibly prevent eversion, and even that is doubtful, it could have no effect in causing inversion. Others agree with Baron Dupuytren, who attributes the direction of the foot in every fracture of the neck to the relative positions of the fractured portions ; and if this explanation be not correct, the cause of inversion in fracture, entirely within the capsular ligament, remains still undiscovered. Mr. Guthrie has explained, in a most satisfactory manner, the cause of inversion in some fractures, without the capsular ligament. If the fracture be so situated, that the attachments of the rotators outwards inserted into the digital cavity, are connected with the fragment between the fracture and the joint, and the attachments of the anterior fibres of the *glutæus medius* and *minimus*, to the anterior part of the trochanter major, are connected with the bone beyond the fracture, then the anterior fibres of these muscles will produce rotation inwards. This explanation, however, though most satisfactory in certain fractures without the capsular ligament, will not apply to fractures entirely within it.

III. Another distinguishing peculiarity of fracture, is the absence of a fixed condition of the limb. It cannot usually be moved by the voluntary efforts of the patient, but it can be lengthened, or turned inwards or outwards by the surgeon, on the application of very slight force, but it returns to its former position as soon as the force is removed. This is a good diagnostic symptom, for distinguishing a fracture with the rare symptom of inversion from dislocation, in which the extremity is fixed, and cannot be restored to its former position, without very great force, and when restored, it remains in the proper position, and the natural mobility returns.

IV. Crepitus is another symptom. If the patient be placed in the horizontal position, and the limb, if retracted, lengthened so as to bring the fragments to a level with each other, it may be readily discovered, by placing one hand over the trochanter major, and giving to the limb a quick rotatory motion with the other.

V. The degree and kind of revolution performed by the trochanter under the hand, when the limb is rotated, is an evidence of the existence of fracture, and of its proximity to the trochanter. When the neck of the bone is entire, the trochanter during rotation describes a segment of a circle, the centre of which is in the joint ; but in fracture it seems to turn on its own axis, or to describe an arc of greater or less extent, according to the distance or proximity of the fracture to the trochanter.

VI. The other symptoms are, pain, which is less in this than in the other fractures of the neck, and is not much felt, except when the limb is moved ; and some unnatural appearances near the injury, such as the trochanter being less prominent than usual, and too near the crista of the ilium ; and there being an unusual fulness of the hip caused by the

bulging out of the muscles between the ilium and trochanter, and a swelling, more or less conspicuous, at the upper and fore-part of the thigh. The only injuries for which this fracture could be mistaken, are dislocation forwards of the hip-joint, when the fracture, as is usual, is attended with eversion (the diagnosis between them will be pointed out when the dislocation is described); and dislocation upwards or backwards, when the fracture is attended with the rare symptom of inversion.

In the dislocations the shortening is greater; the inversion is much more than even in the rare instance of its being found in fracture; the knee is brought forward; there is immobility of the whole limb, and the absence of crepitus; whereas in fracture with inversion the shortening and inversion are less; the limb is so movable, that by a very slight force it may be rotated, or bent backwards and forwards, which, however, causes great pain, and there is crepitus and the peculiarity of the revolution of the trochanter.

EXTRA-CAPSULAR TRANSVERSE FRACTURE.

Symptoms.—Shortening. According to Sir Astley Cooper, this varies from half to three quarters of an inch; but, according to Mr. Smith, with whom most surgeons agree, it is usually from one inch and a half, to two inches and a half. Smith, Boyer, Stanley, and Earle, have all found the shortening greater in this than in the former fracture, there being nothing to prevent the muscles from drawing up the outer fragment, while the inner fragment is pressed down by the weight of the body.

Eversion of the foot. *Inversion* also sometimes, though rarely occurs, as has been stated under the same symptom in the last fracture. There is always, as some term it, rotatory derangement of the limb, and for the most part, outwards.

Crepitus is another symptom, which can generally be elicited without difficulty, as in the former fracture.

Mobility of the limb, which though immovable by the voluntary efforts of the patient, nearly to the same extent as in dislocation, can be bent, extended, lengthened, or rotated outwards and inwards by the surgeon by slight force, but it returns to its former position when the force is discontinued.

Pain, to a greater extent than in intra-capsular fracture, even when the limb is at rest, and always exceedingly severe, when it is moved by the surgeon. The severity of suffering is much greater than in the former fracture, and there is sometimes, in consequence, considerable irritative fever.

It may also be remarked, that the trochanter is less prominent than usual. If the hand be placed over it when the limb is rotated, it will seem to move on its own axis, instead of describing an arc; it is too near the crista of the ilium. The hip is altered in form, as in the last-

Fig. 29.



mentioned fracture. There is swelling at the upper and fore-part of the thigh; and ecchymosis and tenderness to the touch are often observed. This fracture, though it may take place in old age, is often met with under fifty, and sometimes in early life, and is usually occasioned by much greater violence than is necessary to produce intra-capsular fracture.

OBLIQUE FRACTURE OF THE NECK, EXTENDING THROUGH THE TROCHANTER MAJOR.

Symptoms.—If there be any shortening of the limb (which is not always the case), it is usually to a less extent than in the other fractures.

Fig. 30.



The extent of surface of the fractured part, and the direction of the fracture, often prevent this kind of displacement.

Crepitus is usually perceptible, and generally the foot is turned outwards, but seldom to the same extent as in the other fractures; in some instances it is turned inwards, the rationale of which, as explained by Guthrie, is given in a former page under the head of Symptoms of Intra-capsular Fracture. The foot is benumbed, the patient is unable to sit, and any attempt to do so causes great suffering, nor can he turn in bed without much pain; great tenderness is felt on pressure, and ecchymosis may often be discerned. In some cases the upper part of the trochanter does not obey the motions of the limb, but remains at rest; sometimes it is drawn upwards, and a separation is perceptible between it and the rest of the bone; and if the fracture be very oblique

and below the attachments of the principal rotator muscles, the bone may be drawn up by the *glutæus maximus*, and a considerable shortening of the limb be thus occasioned. This last symptom, however, is more characteristic of oblique fracture of the trochanter major, not extending, or very slightly extending, into the neck.

This fracture is usually the result of very great violence applied to the trochanter.

PERIOD OF LIFE AT WHICH FRACTURE OF THE NECK MOST FREQUENTLY OCCURS.

The patients under Baron Dupuytren with fracture within the ligament, were almost all above fifty years of age; and Sir Astley Cooper says, "I have now been thirty-nine years connected with St. Thomas's and Guy's Hospitals, and for thirty years have enjoyed no inconsiderable share of the surgical practice of London. In the two hospitals there are one thousand and fifty patients, and I believe eight cases of fracture of the upper part of the thigh-bone occur in each year; but in order to avoid exceeding the average number, I will consider them only as five per annum; thirty-nine multiplied by five produce one hundred and ninety-five; adding to these one case only in each year in my private practice of thirty years, they will collectively amount to two hundred

and twenty-five cases. Now in that time I have only known two cases of fracture of the neck of the thigh-bone within the capsular ligament occur under fifty years of age; one was in a patient aged thirty-eight years, who had an aneurism of the iliac artery; and the other was kindly shown to me by that excellent anatomist and surgeon, Mr. Herbert Mayo."

Mr. Stanley has recorded a case in a boy aged eighteen years; and in the museum of Guy's Hospital there is a specimen of fracture of the neck, which, however, involves the trochanter, taken from a child nine years of age. Fracture within the capsule is almost exclusively confined to persons above fifty years of age; it is very seldom met with in adults below that age, and is still more uncommon in children: women of advanced age are more liable to it than men. The causes of these differences will be explained below. The other two varieties of fracture of the neck may take place in advanced life; but they occur under fifty years of age more commonly than intra-capsular fracture, and are usually the result of great violence, whereas a very slight accident is sufficient to occasion fracture within the capsular ligament.

Causes.—The causes may be divided into exciting and predisposing causes. The exciting causes of the several fractures have been arranged by Dupuytren in the following order, according to their frequency:—1. Falls on the trochanter. 2. Direct violence, such as that of a gunshot wound. 3. Falls on the foot or knee. 4. Muscular action, as recorded to have taken place once in tetanus. According to Desault's experience, in twenty-four cases out of thirty, the accident was occasioned by falls on the trochanter; whereas Sir Astley Cooper found the most common cause to be a slip off the edge of the foot pavement. He remarks with reference to fracture within the capsule: "In London the accident most frequently occurs when persons walking on the edge of the elevated footpath, slip upon the carriage pavement; though the descent be only a few inches, yet being sudden and unexpected, and the force acting perpendicularly with the advantage of a lever in the cervix, it produces a fracture in the neck of the thigh-bone; and as a fall is the consequence, the fracture is imputed by ignorant persons to the fall and not to its true cause. Other trivial accidents may also produce this fracture. I was informed by a person, that being at her counter, and suddenly turning to a drawer behind her, some projection in the floor caught her foot and prevented its turning with the body, by which the neck of the thigh-bone became fractured. A fall on the trochanter major will also produce it; but I have dwelt particularly on the *slight* cause by which it is occasioned, that the young surgeon may be upon his guard respecting it; as he might otherwise believe that an injury of such importance could scarcely be the result of a slight accident, and that excessive violence is necessary to break the neck of the thigh-bone: but such an opinion is as liable to be injurious to his reputation as the error of confounding this accident with dislocation. Sir Astley Cooper found the other two varieties of fracture to result generally from a violent blow, or a fall on the trochanter. In fracture within the capsule, when caused in the manner already described, the fall is often the con-

sequence of the accident; in the others, the accident is generally the consequence of the fall.

When a person falls on the great trochanter, the neck of the femur is acted on by that eminence, which has a *point d'appui* on the ground, and by the weight of the body, which acts immediately on the head of the femur. By this action and reaction a force is exerted on the neck of the femur, which tends to make it parallel with the rest of the bone. In falling on the feet, on the contrary, the tendency of the fracturing cause is to force the neck of the femur to form a right angle with the bone, and if this force be exerted on the bone beyond its natural extensibility, a fracture must ensue.

According to the two last-mentioned views of the mechanism of these fractures, they are not direct, that is, not produced by a cause acting immediately on the part, but the effect of a force communicated to that part by *contre-coup*, or transmitted reaction. If, however, the fracture be the result of a severe contusion or fall, and be through the trochanter or without the capsule, the fracture is so near to the part to which the violence is applied that its influence may be said to be direct.

The different degrees of frequency with which these fractures occur at the different periods of life, and in the two sexes, may be explained by anatomical and other considerations. In the child, the trochanter is concealed under the prominence of the os innominatum; the trochanter projects but slightly, and the axis of the neck approaches that of the shaft. These circumstances, together with the diminished breadth of the pelvis, the great flexibility of the neck, and the adipose and cellular tissues which are all protective, account for the extremely rare occurrence of these fractures in childhood. In adults the pelvis is broader, the trochanter is more prominent, the neck is longer, and its inclination to the shaft is at a greater angle; consequently there is more liability to fracture in mature age than in childhood, and there would be still more than there is, but for the great strength and solidity of the bone at that period. In advanced life the pelvis is still broad, the trochanter is prominent, and often but little protected, in consequence of the diminished size of the muscles and the decrease of the adipose and cellular tissue; and the neck of the thigh-bone, besides being nearly at a right angle with the shaft, is also rendered exceedingly brittle by the diminution of cartilaginous matter and the increase of phosphate of lime; also by a peculiar process of atrophy, which has been admirably described by Sir Astley Cooper. To these circumstances is ascribed the greater liability to fracture in old age.

Dupuytren states, that the frequency of this accident bears a direct ratio to the prominence of the trochanter major, the length of the neck, and its angle with the shaft, and he ascribes the greater liability to it in women to the circumstance that the neck of the femur is longer and the trochanter more prominent, while the size and prominence of the muscles which would protect the bone, are often less in this sex than in the other. The very liability to fall in old age must also increase the frequency of fracture. The observations of Sir Astley Cooper, above referred to, are as follows. "The neck of the thigh-bone in persons of middle age has a close cancellated structure, and is covered by a shell of

considerable thickness; but in old subjects the cancellated structure degenerates into a coarse network, loaded with adipose matter, and the shell which covers it becomes so thin that when a section is made through the middle of the head and cervix, it is found diaphanous. Of this I have several specimens. As the shell becomes thin, ossific matter is deposited on the upper side of the cervix, opposite the edge of the acetabulum, and often a similar portion at its lower part, and thus the strength of the bone is in some degree preserved. This state may be frequently seen in very old persons. When the absorption of the neck proceeds faster than the deposit on its surface, the bone breaks from the very slightest causes, and this deposit wears so much the appearance of a united fracture that it might easily be mistaken for it. Before the bone thus alters we sometimes meet with a remarkable buttress shooting up from the shaft of the bone into its head (formed of strong cancelli), giving it additional support to that which it receives from the deposit of bone upon its external surface.

“But another change is also produced, of which the following is the history. Old, bedridden, and fat persons, generally females, often used to be brought into our dissecting-room with some of their bones broken, and more frequently the thigh-bone than any other, in being removed from the grave. If the cervix femoris of such persons be examined, it will be found that the head of the bone is sunk down upon its shaft, and that the neck of the thigh-bone is shortened, so that its head is in contact with the shaft of the bone opposite to the trochanter minor; and at the point at which the ligament is united with the neck of the bone the phosphate of lime is absorbed, and a ligamento-cartilaginous substance occupies its place, either extending (as a plane) entirely through the neck of the bone, or partially, so that one section exhibits signs of it, and in another it is wanting. The bone in some cases is so soft and fragile, both in its trochanters and head, that it will scarcely bear the slightest handling; and the motion of the thigh-bone in the acetabulum is almost entirely lost, so that the persons must have had but little use in their lower extremities. In examining the body of an old subject very much loaded with fat, in the dissecting-room of St. Thomas's Hospital, I found that the gentleman who had dissected one limb had cut through the capsular ligament of the hip-joint, and tried to remove the head of the thigh-bone from the acetabulum, but the neck of the bone broke on the employment of a very slight force, and, upon a farther trial to remove it, the bone crumbled under the fingers. As the other limb was not yet dissected, I requested Mr. South, one of our demonstrators, to remove with care the upper part of the other thigh-bone, but, although he used great caution in doing it, he could not remove the bone without fracturing the upper part of its shaft; but he succeeded in removing the upper part of the bone, so that it might be preserved; and of this I have given plates. We have here then a case in which the neck of the bone was absorbed, so that the head was brought in contact with the trochanter; in which, most decidedly, there had not been a fracture, although it had in some parts the appearance of one, and in which the disease occurred in each hip-joint.

“Another case of the same kind was examined by Mr. South, which,

so far as it relates to the softened state of the upper part of the thigh-bone, was similar to the former; the heads were spongy, the necks were shortened, so that there was scarcely any remaining; each trochanter was light in weight and very large; and there was little, if any, motion in either of the hip-joints, so that both limbs appeared, at first sight, as if dislocated on the pubes. But the best specimen of this state is the following, which I preserve with the most assiduous care, and value in the highest possible degree. I have had, for twenty years, in the collection of St. Thomas's Hospital, the thigh-bone of an old person, in which the head of the bone had sunk towards its shaft. I have been in the habit of showing this bone twice a-year, as a specimen how bones sometimes become soft from age and disease, and from the absorption of their phosphate of lime; and I have frequently cut with a penknife both its head and its condyles, to show the softened state. On sawing through its cervix, the cartilage, deprived of its phosphate of lime, had dried away in several parts; and the appearance was such, that a person ignorant of the change would have declared it to be a fracture, only that in some sections the cartilage has taken different directions (as a thin plane between the head and neck), and in some, the bone was not yet entirely absorbed."

MODE OF UNION.

In two of the three kinds of fracture of the cervix femoris, namely, extra-capsular transverse fracture, and oblique fracture through the trochanter major, the reunion is, as in other parts of the body, by bone; but this mode of union is extremely rare in intra-capsular fracture. It was at one time a question about which there was much difference of opinion, whether reunion by bone could ever take place in fracture entirely within the capsular ligament, and where the head of the bone is completely insulated, except at its attachment to the acetabulum by means of the round ligament. The French surgeons believed that it could, and affirmed that preparations in their museums in Paris demonstrated that mode of union. Several British surgeons were of the same opinion. M. Roux of Paris sent a specimen of what he believed to be reunion by bone, to Sir Astley Cooper; but Sir Astley was not satisfied, because the traces of reunion in that preparation were such as to indicate a fracture where the internal fragment retained a connexion with the capsular ligament. Mr. Cross of Norwich, in the account of his visit to the French hospitals, states that he examined the preparations in the museums of Paris, which were believed to demonstrate union by bone, but that he did not consider them satisfactory.

No one in this country has devoted more attention to the investigation of this subject than Sir Astley Cooper; and to show how rare an occurrence union by bone is in fracture entirely within the ligament, he enumerates not fewer than forty-three specimens of this fracture in different collections in London, and states that during his practice of forty years he had seen but two or three cases which militated against the opinion that union by bone cannot take place, and only one in which a bony union had taken place, or which did not admit of motion of one bone upon the other. Sir Astley Cooper never denied the possibility

of bony union; he states that it would be presumptuous to maintain that there could be no exception to the general rule; but he has proved that such exceptions are rare. Several cases are recorded, in which bony union unquestionably took place; and we may therefore conclude that it may occur in very favourable cases, and under good treatment. Of various instances on record, I shall only refer to three.

Mr. Longstaff's museum contained an unquestionable specimen of ossific union. The preparation is now in the Museum of the Royal College of Surgeons of England, where I have examined it. The particulars of the case are recorded in the "*Medico-Chirurgical Transactions*." The patient died about two years after the accident. The ossific union is perfect in the shell, and all round the circumference of the bone; the centre of the fissure is united by a fibrous substance.

Another instance of bony union occurred in the case of Dr. James, an English physician, who met with this fracture by a fall from his horse, while riding in the neighbourhood of Bordeaux. He recovered from the accident, but died seven months after it, of visceral disease; and, on examination by Dr. Brulatour of Bordeaux, it was found that the fracture was entirely within the capsule, and that the union by bone was perfect.

In the second edition of Mr. Liston's "*Elements of Surgery*," p. 717, there is a drawing of complete bony union, which, Mr. Liston says, he is enabled to produce by the kindness of Sir Astley Cooper. The possibility of bony union is thus clearly demonstrated, but still it cannot be looked for except in very favourable cases, and what has been already described as the frequent condition of the neck of the thigh-bone in aged persons, must render it in many instances hopeless. In the majority of cases of intra-capsular fracture, no union takes place, and the broken surfaces become smooth and polished from being covered over by what has been called the ivory deposit, or they may become joined to each other, or to the inner surface of the capsular ligament by fibrous bands, the capsular ligament and surrounding tissues become very much thickened and strengthened, and thus the unnatural motion is limited. The neck of the femur disappears by interstitial absorption, and the diminished head rests between the two trochanters. These conditions, or some combinations of them, are the appearances which present themselves where bony union has not taken place.

Fig. 31.



CAUSES OF THE WANT OF UNION.

1. One circumstance which prevents bony union of the fragments is

Fig. 31. Intra-capsular transverse fracture of cervix femoris, followed by absorption of the neck, and conversion of part of capsular ligament into exceedingly thick bands. From a preparation in my museum.

the want of proper and constant apposition. This is only in accordance with what is observed in other parts of the body, when fractured bones cannot be kept in contact. Under such circumstances ossific union rarely takes place, as may be clearly seen from the various cases and experiments recorded in the last edition of Sir Astley Cooper's work on "Fractures and Dislocations," beginning at page 139.

2. Various proofs may be adduced that a certain degree of pressure of the fractured parts against each other is favourable to union. In the present case that pressure cannot easily be maintained, and this is another circumstance which contributes to prevent union.

3. The atrophy of the cervix femoris, already described, not only predisposes to fracture, but also diminishes in a very great degree the power of reparation. This, and the want of vigour belonging to old age, even if no other reason could be assigned, would be sufficient to account for the want of union.

4. A fourth reason is the feeble circulation through the head and neck on the inner side of the fracture, for, there being no periosteum, its circulation and vitality are kept up entirely by the vessels of the round ligament; nor can the separated portion of the bone receive nutrition from any other source.

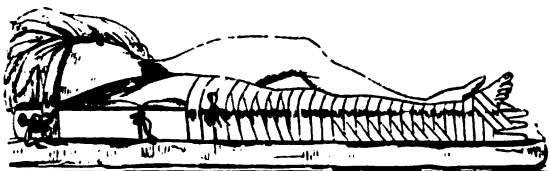
5. Another reason which has been assigned is, the circumstance of the synovial fluid being poured into the injured cavity; but the effect of this is doubtful.

Treatment.—The first question is,—Are we justified in subjecting the patient to the long and hazardous confinement to his bed necessary for a chance of union? The answer to this will depend on the degree of probability that union will take place. It will now be evident that the inquiries into the changes which the neck of the bone undergoes in age, the circumstances under which reunion takes place, and the causes which prevent it, are of great practical importance. In intra-capsular transverse fracture in advanced life, when there is little if any chance of reunion, it would be injudicious to run the risk of ruining the general health by long confinement to one position, and incur the danger of ulceration and sloughing of the integuments of various parts from the weight of the body, and the application of apparatus for adapting and retaining the parts in apposition. Sir Astley Cooper remarks, "Baffled in our various attempts at curing these cases, and finding the life of the patient occasionally sacrificed under the trials made to unite them, I should, if I sustained this accident in my own person, direct that a pillow should be placed under the limb throughout its length, and that another should be rolled up under the knee, and that the limb should be thus extended until the inflammation and pain be subsided. I should then daily rise and sit in a high chair, in order to prevent a degree of flexion which would be painful, and, walking with crutches, bear gently on the foot at first, then gradually more and more, until the ligament became thickened, and the muscles increased in their power. A high-heeled boot should be next employed, by which the halt would be much diminished."

In extra-capsular transverse, and in oblique fractures through the trochanter, and even in intra-capsular transverse fractures in very favourable subjects, the following treatment may be adopted.

The patient being placed on a hard mattress, in an extended position, with the trunk, thigh, and leg in a straight line, a common bandage being applied from the toes to above the knee, to prevent œdema, and coaptation having been obtained by extending the extremity, and placing it in a proper position, with the toes not too much turned inwards or outwards, a wooden splint of sufficient strength and breadth, and long enough to extend from the last rib to three or four inches beyond the foot, with two holes at its upper, and two notches or retiring angles at its lower, extremity, should be well padded and applied to the outer side of the limb, care being taken to protect the ankle by a suitable adjustment of pads. The leg and foot should then be fixed to the splint by a roller, from the foot to above the knee; and if the roller, after some turns of it have been applied to the ankle, be passed through the notches, it will fasten the foot to the extremity of the splint, and prevent it from moving. A broad bandage should be applied around the pelvis, and

Fig. 32.



carried down the thigh so as to include all the part above the former roller, and by the turns of this bandage, or by a very broad band, the splint should be fastened to the trunk, by which means the fractured parts will be kept in contact. A large handkerchief or shawl, with a little tow or hair wrapped up in it to prevent its galling the skin, should be applied with its centre in the perineum, and one end behind the hip and the other in front, and these ends passing through the openings in the upper part of the splint, should then be well secured. The pelvis acts as a fulcrum, and the perineal band as the power, by tightening which the splint and the lower part of the limb previously fixed to it can be kept down, the extension be preserved, and the extremity be kept of the proper length. Great care should be taken that the splint be well padded with cotton, wool, wadding, or tow, to prevent the painful effects of pressure; the bandages should be reapplied occasionally during the treatment, and the perineal band frequently tightened. The apparatus will require to be continued for at least seven or eight weeks; but this will vary in different cases, according to the time necessary for procuring union. As satisfactory cures are obtained by this method as by any that can be adopted, and it has the recommendation of being simple and the least annoying of any to the patient. It has been strongly advocated by Mr. Liston, Professor Samuel Cooper, Mr. Fergusson, and others.

The indications of treatment to be fulfilled are, to preserve the extremity elongated, and at perfect rest, to prevent eversion, and to keep up pressure upon the trochanter.

Some recommend a different plan of treatment, namely, to keep the

body slightly elevated, and the limb on a double-inclined plane. This treatment can be more conveniently practised by means of Amesbury's bed than by any other apparatus. The first and third indications above stated are fulfilled by the footpiece of Amesbury's bed; the bed itself accomplishes the second; and the fourth and last is effected by a bandage or belt around the trunk, and a splint extending between the pelvis and the knee. I have treated cases satisfactorily by each of the above plans; but my decided impression is that the former is to be preferred. Dupuytren recommended the double-inclined plane, and kept the extremity elongated by means of two belts, one of which he passed along the perineum, and attached to the upper bed-post; the other he fixed to the knee, and fastened to the lower bed-post.

FRACTURES OF THE SHAFT OF THE FEMUR.

Symptoms.—These are so conspicuous as at once to satisfy the surgeon of the nature of the injury. Acute pain at the moment the injury takes place,—inability to sustain the superincumbent weight,—angular deformity in raising the limb,—sudden inability to move the limb by the voluntary action of its own muscles,—and preternatural motion of the lower part of the thigh-bone when otherwise acted on,—are invariable symptoms; and the following, though not always, are generally present.

There is shortening of the extremity, if the fracture be oblique, varying in extent according to the obliquity. To ascertain the extent of shortening, or longitudinal displacement, as it is sometimes called, take the anterior superior spinous process of the ilium and some prominent point at the under extremity of the femur, or head of the tibia, and compare the measurement with that between the corresponding parts on the opposite side of the body. Shortening of the limb may be prevented by the bone being splintered, and the two fractured extremities being locked into each other. This symptom may not appear immediately, the contractions of the muscles by which it is produced being gradual. If the fracture be transverse, there may be no shortening, unless the violence which produced the injury was so great, or applied in such a manner, as to force the lower fragment from resting at any point against the upper.

Crepitation may be generally elicited, more especially if the fracture be transverse, by performing rotatory motion. If the fracture be oblique, this symptom may not be perceptible, until the limb has been elongated. The presence of crepitus is an indubitable proof of the existence of fracture, although its absence cannot be taken as an indication of the contrary; for it will sometimes be altogether prevented by the interposition of muscular fibres between the fractured portions.

Tumefaction to a considerable extent may be present, the foot is for the most part turned a little outwards, and the femur is most accessible to the fingers along its sides.

Nature of Displacement.—If the fracture be oblique, and if it be not very near either of the extremities of the shaft,—in which case there are some modifications of the displacement which will afterwards be stated,—

the part above the fracture has generally two, and the part below four peculiarities of displacement. The upper fragment is drawn too far forwards by the *psoas magnus* and *iliacus internus* muscles; which, in their way from the iliac fossa and lumbar division of the spine to the trochanter minor into which they are inserted, describe an arc, the convexity of which is forward. There being no longer the usual resistance offered to the contraction of these muscles they draw forward the upper fragment. It is also generally drawn a little outwards by the *glutæus maximus* muscle. Of course the upper part of the bone can undergo no retraction. The part below the fracture is displaced in the four following directions:—

1st. It is displaced backwards, chiefly perhaps by its own weight, and by being overlapped by the upper part.

2d. It is drawn too near the mesial plane. The course of the adductor longus, brevis, and magnus, is from within outwards, and thus these muscles draw, or as their very name imports, they adduct, the lower fragment too near the mesial plane.

3d. It is rotated outwards, thus occasioning eversion of the extremity. Some attribute this eversion to the mere weight of the limb, but as many of the fibres of the adductor muscles have the planes of their insertion farther back than the planes of their origin, it is probable that they assist in producing rotation outwards, and they will have a greater tendency to do so on account of the falling back of the lower fragment, which makes the plane of their insertion farther back than usual from those of their origin.

4th. It is drawn upwards, producing shortening of the extremity. This displacement is occasioned chiefly by the muscles which go between the pelvis and the leg, namely the biceps, semi-tendinosus, semi-membranosus, rectus, and gracilis, assisted, no doubt, by the muscles inserted into the fragment below the fracture. If, however, the fracture be transverse, it may happen, on account of the breadth of surface of the fracture, that some part of the lower fragment presses against some part of the upper, in which case there will be no shortening; but if the fracture be oblique, the contraction of the muscles will not be prevented by the position of the fractured portions, and consequently, shortening will take place.

According to Mr. C. Aston Key, the displacement in fracture of the femur is not to be attributed to the action of the muscles inserted into the upper fragment; but chiefly to that of the muscles which go to the lower fragment. He supposes that the muscles surrounding the fracture and inserted into the lower fragment become the subject, first of effusion of blood, and subsequently of serous infiltration in consequence of slight inflammation, and that they are thereby irritated, swelled, and excited to contract; and the lower fragment being movable is thus drawn up. The direction of the upper fragment, according to Mr. Key, will then depend upon the direction of the plane of the fracture. If the fracture go from above downwards, and from within outwards, the lower fragment by being drawn upwards, presses the upper fragment forwards and outwards. If the plane of the fracture be from before backwards, and from without inwards, the effect of drawing up the lower fragment

will be to displace the upper fragment forwards and inwards. According, therefore, to this authority, the displacement of the upper fragment is not so much caused by the action of its own muscles, as by the lower fragment, and the direction in which the upper fragment is displaced, by the drawing up of the lower, depends on the direction of the plane of the fracture. If the fracture be situated at the upper extremity of the shaft, the *psoas magnus* and *iliacus internus* draw the upper fragment directly forwards, producing a tumour in the groin; and if the fracture be transverse and immediately above the condyles, the lower fragment is drawn downwards and backwards by the *gastrocnemius externus*, *plantaris*, and *popliteus*, so that the lower extremity of the upper fragment appears as if it were the part displaced.

Treatment.—After coaptation of the fractured portions, which should be obtained as speedily as possible, the object of treatment is to preserve the parts at rest and properly adjusted; which can be done by attention to attitude and application of apparatus.

Attitude.—Various attitudes have been recommended. Desault advises that the patient be placed on his back on a hard unyielding mattress, with the trunk, thigh, and leg in a straight line with each other; this attitude he employed partly with a view of giving ease to the patient, but chiefly that the muscles might be equally relaxed; and apparatus be easily applied for keeping the limb extended, and at rest.

A second attitude, now however completely abandoned, is that recommended by Pott, in which the patient is placed on the affected side with the trunk slightly inclined forwards, and the leg moderately backwards.

For a description of this method of treatment see Pott's *Surgical Works*, vol. i. p. 318. A most decided objection to it is that it does not admit of extension, so that shortening and deformity of the limb, and eversion of the foot, are extremely apt to result from it. It is also exceedingly irksome to the patient.

A third attitude is that proposed by Sir Charles Bell, in which the patient is placed on his back with the trunk raised, the thigh slightly bent on the pelvis, and the leg bent on the thigh.

Mechanism.—This is, likewise, very various. The splint of Desault and also that of Boyer are appliances which were successfully employed by these celebrated surgeons, and although very complicated and cumbersome, and not now employed in this country, yet they were useful on the very same principle as the apparatus now in most general use, and no doubt led to its introduction. The apparatus to which I allude is, in fact, the mechanism of Desault simplified; it has been very strongly recommended by Mr. Liston, and is now generally approved, and adopted in all fractures of the shaft, except those at its very extremities.

This plan of treatment being the same as that recommended for fracture of the neck of the femur, with the single exception that in addition to what is there used, a short wooden splint should be applied to the inside of the thigh, it is unnecessary again to describe it. It is of all methods the easiest to the patient; it prevents eversions, shortening and deformity; and the mechanism is so applied that the pelvis, thigh, leg, and foot constitute one rigid body, which may be moved entire, but the various parts of which being immovable *inter se*, preserve the same mutual

relation. Some surgeons object to the treatment above described, if the fracture be at the upper extremity of the shaft and immediately below the trochanter minor, on the ground that—1st. The *psoas magnus* and *iliacus internus* muscles having no antagonists, and being put on the stretch by the straight position, will draw the upper part too far forward; and 2d. The perineal band, if made very tight,—and if it be not made tight it cannot answer the purpose for which it is employed,—will tend to assist the two muscles in increasing this displacement of the upper fragment. In consequence of these objections to the straight position, they advise that the patient be placed in the attitude recommended by Sir Charles Bell for the treatment of fractures of the shaft, but with this peculiarity, that the trunk should be so much raised as to make the patient sit erect for the purpose of relaxing the *psoas magnus* and *iliacus internus* muscles; and that four wooden splints be applied, one to the front, another to the back, and one to each side of the limb. If the fracture be so nearly transverse that the upper fragment by pressing against the lower, may prevent its retraction, this treatment may answer; but if the fracture be at all oblique, I would recommend the former plan, which I have employed, even in this fracture, with the most satisfactory result. This fracture can be very conveniently and satisfactorily treated in the bent attitude, referred to above, by means of Amesbury's admirable apparatus or fracture-bed, for fractures at the upper part of the femur, along with four wooden splints, firmly applied to the front, back, and two sides of the thigh. This apparatus renders it unnecessary to move the patient's body for any purpose, and it has also the great advantage of making it practicable and easy to keep up extension, and thereby to prevent shortening of the limb.

In transverse fracture, immediately above the condyles, or in the under third, the preferable attitude is to have the leg slightly bent, to relax the *gastrocnemius externus*, *plantaris*, and *popliteus* muscles, which draw backwards the lower fragment. The most elegant apparatus for the treatment of fracture in this situation, is M'Intyre's splint, which consists of a sandal, and leg and thigh-pieces; the latter two forming a double inclined plane with each other. The thigh-piece is double, the one portion sliding on the other, and can be lengthened or shortened, and firmly fixed by means of a screw. By lengthening the thigh-piece, which can be done without removing it from the patient's body, extension of the thigh can be kept up. The leg and thigh should be included in a roller along with the splint; three short wooden splints should also be applied to the lower part of the thigh, namely, one in front and one on each side, and the roller should be carried up to the upper part of the shaft. By the above means the fractured portions will be kept in apposition and at rest: the whole of the extremity may be moved along with the splint, but the fractured portions will be preserved in contact, and their proper relations to each other effectually maintained. In oblique fracture in the under third, notwithstanding the action of the muscles above referred to, I prefer the straight position, as that in which extension can be most effectually kept up, and shortening and deformity consequently prevented.

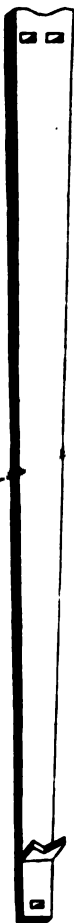
[In this country fractures of the thigh are generally treated by an

apparatus which retains the limb in an extended position. The principle of Desault's splint is the basis of numerous inventions, but the modification of it by Dr. Physick is perhaps the most preferred.

The pieces which compose Desault's apparatus, are, 1st. Common junk-cloth, accommodated to the size of the limb and the splints; 2dly. A bandage for the body, and one passing under the thigh, to secure the first on the side opposite to the fracture; 3dly. Three stiff splints, an inch and a half wide, the external one of which being very strong, must be long enough to extend from the spine of the ilium to the distance of four inches below the sole of the foot. This splint is hollowed out or notched at its lower end, and has a mortice in it a little higher up. The upper splint occupies the space included between the fold of the groin and the upper part of the knee; and the internal one, which reaches from the upper and internal fold of the thigh, to the sole of the foot; 4thly. Three bolsters, an external, an internal, and an upper one, consisting of small bags of chaff; 5thly. A bandage of strips, accommodated, as to number, to the circumstances of the case, separate from one another, each three inches broad, and long enough to go twice round the limb, arranged from below upwards, and overlapping each other, about one-third of their breadth; 6thly. One long and two circular compresses, intended to be applied immediately on the limb, next to the skin; 7thly. Two strong rollers, intended for extension and counter-extension, at least an ell and a half long; 8thly. One long and thick compress, and a sufficient number of bits of tape.¹

In this apparatus the line of the counter-extension is very oblique, owing to the perineal band being attached to the upper end of the splint, and the obliquity has a tendency to produce deformity, by inclining the upper fragment outward.

Dr. Physick elongated the upper end of the splint so as it should reach to the axilla, and thus the line of the counter-extending band was rendered very nearly parallel to the axis of the body; and at the suggestion of Dr. Hutchinson, a small notched block is attached to the inner surface of the lower extremity of the splint. The extending bands passing over this notch necessarily act in a line parallel with the splint. In other respects Physick's apparatus is the same as that of Desault, although the third or anterior splint will not be found necessary in many cases. In applying this apparatus great care is requisite to render it effectual, and at the same time as comfortable as possible. Much will depend upon the accuracy of the adaptation of the bran-bags, and upon the character of the material used for the extending and counter-extending bands. The great ground of complaint which has been urged against this dressing has arisen from a liability of excoriation at the perineum, and at the ankle. The perineal band should be made of soft yet firm muslin, and padded or stuffed in that part which presses against the perineum. The skin should be carefully examined



¹ Caldwell's Translation of Bichat's edition of Desault's Surgery.

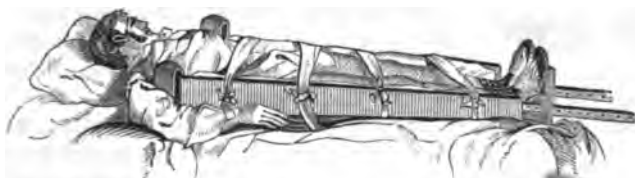
every day or so, and bathed with soap liniment. The extending band applied at the ankle may consist of a handkerchief or a gaiter to which strong tapes have been fastened, and benefit will result from changing the means of extension and counter-extension.

Hagedorn's apparatus is the least liable to objection on the ground of excoriation, there being no perineal band, and the counter-extension being made at the acetabulum of the sound side. Prof. Gibson, of the University of Pennsylvania, has modified this splint, and this apparatus is well known in this country. Dr. Gibson thus describes the original apparatus, and his improvement:

"This method consists in extending the patient's limbs upon a mattress, and confining both feet, by gaiters or a handkerchief, to a foot-board, which is firmly secured upon the ends of two splints passed through mortices near its edges. These splints extend from the arm-pit, where they are padded like the head of a crutch, along each side of the body, thigh, and leg, beyond the foot, and, being well stuffed on their inner surfaces, to prevent irritation, are confined by six or eight broad tapes or bandages passed around the limbs, pelvis, chest, &c.

"The principle upon which extension and counter-extension are effected by this contrivance will instantly be understood. The sound limb being extended serves as a splint to the broken one. Counter-

Fig. 34.



extension then is made upon the *acetabulum* of the *sound side*, and extension upon the ankle of the injured limb, which, so long as the two feet are kept on the same level, cannot be shortened, provided rotation of the pelvis be prevented. This purpose is answered by extending the splints to the arm-pits, and not with a view, as might be supposed, of producing counter-extension at these points. Finding that the patient, in the original machine of Hagedorn (which consists of a single splint merely, and a foot-board, independently of leather straps, &c.), could incline the pelvis towards the affected side, and thereby shorten the limb by causing the superior fragment to descend and overlap the inferior, the additional splint was added, and has been found to answer completely the end designed." (Gibson's Surgery, Vol. I.)

If both thighs are fractured, the best plan of treatment is that recommended by Dr. Gibson. It consists in securing the feet to the upper extremity of a single inclined plane, by means of gaiters attached to a foot-board. The extension is made by the weight of the body.—Ed.]

OBLIQUE FRACTURE OF EITHER CONDYLE.

Symptoms.—This injury may be recognised by the crepitus which is felt on taking a firm hold of the condyles of the femur, and producing

flexion and extension of the knee-joint. The mobility of the condyle is caused by the alternate contraction and relaxation of the gastrocnemius. When the leg is very much bent, a fissure may sometimes be detected. From the extension of the fracture into the joint, it is sometimes followed by inflammation of the knee-joint, and by that means has been known to give rise to serious consequences.

[When both condyles are fractured, the symptoms are usually still more distinct. There is usually great mobility of the parts, and crepitation would be very distinct. Upon flexing the knee, its breadth is greatly increased by the separation of the condyles, and the patella sinks deeply in the space between them. It is possible, however, that a fracture of both condyles may occur, and yet the most striking symptoms be wanting.

Fig. 35.



A case of this kind has been reported by the editor in the July No. of the American Journal of Medical Sciences, 1849. The injury was produced by jumping from the third story window of the Almshouse Hospital. There was neither crepitation, mobility, nor twisting of the limb. Passive flexion and extension of the leg was readily effected. There was no increased breadth at the knee-joint. The deformity resembled a partial dislocation of the knee backwards. The leg was thrown back-

ward, and the patella was very prominent.

The patient recovered rapidly without a bad symptom, and about a year after died of typhus fever. The specimen, as can be seen from the wood-cut, shows but slight shortening and no increase of breadth at the articular extremity. The fragments were probably impacted, the structure being cellular, and the force of the counter-stroke in a fall from such a height being very great.—Ed.]

Nature of Displacement.—The vasti muscles passing around the condyles, to be inserted into the patella, prevent great displacement. The fragment, however, has a tendency to be slightly drawn backwards by the gastrocnemius externus, and if the fracture be of the inner condyle, besides being slightly drawn backwards, it is also drawn a little upwards by the adductor magnus.

Treatment.—The same treatment is pursued, whether there be fracture of the external, or internal condyle. The extended position is by all preferred, because the head of the tibia, acting as a splint, resists displacement. Pasteboard or gutta-percha splints, moistened in warm water, should be applied by means of a roller. In these injuries, inflammation within the cavity of the joint is much to be dreaded; the use of pressure, therefore, by the above mechanism must be deferred until all inflammation has subsided. The rule to be observed is to keep the proper attitude from the commencement, but not to apply the mechanism until all danger of inflammation is past.

[In fractures of either or both condyles it may be necessary to make

extension and counter-extension, which can readily be effected by Physick's modification of Desault's Splint. At the end of four or five weeks, passive motion should be commenced, to prevent stiffness of the joint.—Ed.]

FRACTURES OF THE PATELLA.

Fractures of the patella are either transverse or longitudinal; the former are more frequent than the latter, the exciting causes being more numerous. Fractures of this bone may be either simple or compound; but the compound fracture is fortunately of comparatively rare occurrence.

Fig. 36.



Fig. 37.



Transverse fracture.—This injury may be produced by direct violence, such as a fall or a blow, or by violent contraction of the four strong extensor muscles of the leg attached to the patella. Persons have been frequently known to meet with this fracture from the last-mentioned cause, while ascending a stair; and the reason of this may be easily understood. The ordinary action of the rectus femoris and triceps extensor cruris is to bring the leg forward; this they do by having their fixed points of attachment above, and they then extend the leg by drawing up the patella, which, through the medium of the ligamentum patellæ, brings the leg forward. In ascending a flight of stairs the action of the muscles is exactly the reverse. When the leg is raised on the step to be ascended, the patella is made the fixed point of the attachment of the muscles, and in the half-bent position in which the leg is placed, the patella rests only by a small part of its posterior surface on the femur, its two extremities, and especially its apex, being unsupported. The four muscles, by their contraction, then raise up the femur, so as to be in a line with the leg, and while they do so, it is evident that the patella has to sustain the whole force of muscular action, together with the weight of the body. The apex of the bone has a tendency to be drawn downwards, and the upper part backwards, by the extensor muscles, so that while the middle part rests on the femur, and has to sustain the whole superincumbent weight and muscular action, if these be too much for the strength of the bone, it snaps, and the muscles having thus lost their under-fixed attachments, can no longer support the body, which consequently falls backwards. It is a popular mistake that the fall is the cause, whereas it is in fact the consequence, of the accident. This explains the reason why this accident frequently happens to an individual ascending a flight of stairs with a burden on his back. This fracture has also been known to take place during an attack of convulsions, while the patient was stretched on his back; and a case

is on record in which it was produced by placing the body of an individual in the position necessary for performing the operation of lithotomy, and the straining of the muscles during the operation.

Symptoms.—The fracture may be easily known by the two projections formed by the fragments, and the unnatural depression between them, into which the fingers may be pressed down towards the femur, as far as the integuments will permit. The extent of the depression will depend on whether the ligamentous expansion covering the anterior surface of the patella be lacerated or not. The two fragments are easily movable, but any lateral movement of them is attended with pain. On bending the leg on the thigh, the space between the fragments is increased; it is diminished in bending the thigh and extending the limb. The patient has not the power of extending the leg, nor of supporting the weight of the body on that leg, as the knee bends forwards when the weight is placed upon it, from the loss of action in the extensor muscles. The manner in which the patient attempts to bring his leg forwards is also diagnostic; he leans the body forward, and then swings forward the whole of the extremity by calling into action the muscles which bend the thigh upon the pelvis. The nature of the violence, and the tumefaction which quickly follows from the extravasation of blood and secretion of synovia, are indicative of the character of the injury.

Nature of Displacement.—The lower fragment remains in its natural position, and follows, together with the ligamentum patellæ, the motions of the leg; the upper fragment is drawn upwards by the four extensor muscles. The distance of the fragments from each other is increased by the bent position of the leg; but it varies, according as the tendinous expansion from the muscles over the bone is more or less lacerated. If the aponeurosis escape with very little laceration, the separation of the fragments may be limited to a very small extent; whereas, if it be completely lacerated, they may be removed some inches from each other.

Fig. 38.



Sir Astley Cooper says the upper portion may be drawn up five inches, and others have referred to a specimen in the museum of St. Thomas's Hospital, in which the two fragments are connected by a broad structure fully five inches in length.

Mode of Union.—Transverse fractures of the patella are very rarely united by bone, but in almost all cases by a ligamentous substance. It

was long supposed that there was something peculiar about the structure of the patella which was unfavourable to the fresh formation of bone. Baron Larrey was the first who questioned the existence of this supposed peculiarity: he ascribed the rarity of bony union to the difficulty of keeping the fragments in immediate apposition; and the correctness of his view, both as to the possibility of union by bone, and the cause of its rare occurrence, is now completely proved.

That after fracture of the patella the union may take place by bone, can no longer be denied. In longitudinal fracture of the patella, it is even acknowledged to be the usual mode of union,—so frequently does it occur. In transverse fracture, though it is rarely met with, yet its possibility is incontestably proved. Sir Astley Cooper says:—"In a patient of my kind friend, M. Copart, of Paris, I once saw a case which appeared to me to be united by bone; and Mr. Fielding, of Hull, has published a similar case." Sir Charles Bell, in his work "On Injuries of the Spine and Thigh-bone," says, p. 57:—"This very week a woman goes out of the Middlesex Hospital with a fractured patella united by bone, and you can feel the ridge of union. Admitting that we may be deceived in this, there can be no deception in the preparation, which I place in your hands; you have the patella shattered and reunited by bone, and you perceive the fragments are united with perfect regularity." At p. 58, he says:—"I have besides, eight specimens of fractured patella reunited by ligament, and two by bone. The ninth specimen decides the matter. You see that the fracture has not only been across, but that there has been a rent longitudinally." M. Lallement records an unequivocal specimen of union by bone in transverse fracture. It was proved by dissection of the part, after the death of the patient, from another affection. Mr. Wilson has found in dissection, specimens of union by bone in transverse fracture, and the collection of Dr. William Hunter is said to contain a well-marked example. On the possibility of bone being formed in fracture of the patella, there is now no difference of opinion; and that the cause of its extreme rarity in transverse fracture is the want of correct apposition, appears evident from the following considerations:—

1. Bony union is very common in longitudinal, and very rare in transverse fracture; and it seems difficult to assign any explanation of the difference, except the comparative facility in the one case, and the extreme difficulty in the other, of preserving the parts in apposition.

2. If in longitudinal fracture the soft parts be so lacerated that it is difficult to preserve the fragments in apposition, then ligamentous union is the usual result. This seems to show clearly that the obstacle to bony union is the want of apposition.

3. In the case recorded by Sir Astley Cooper of Mr. Marryatt, who was thrown from his gig as he was passing along the Strand, there was transverse fracture of the patella, and the lower fragment was also broken perpendicularly, so that the bone was divided into three pieces. The transverse fracture united by ligament, but the perpendicular by bone.

4. In several instances Sir Astley Cooper divided the patella transversely in rabbits, by drawing the integuments to one side, and then

placing a knife upon the bone, and striking the knife lightly with a mallet. He states, that in no instance in which he performed the experiment, either in the rabbit or in the dog, did he ever succeed in obtaining bony union. He performed the experiment of dividing the bone longitudinally both in the rabbit and in the dog; and when the precaution was taken not to divide the tendinous fibres above, nor the ligament below, so that the fragments were preserved in close apposition, bony union was readily obtained; whereas, if these precautions were not attended to, the union was ligamentous.

5. Mr. George Gulliver has, in the "Edinburgh Medical and Surgical Journal," related a series of experiments on transverse division of the patella, in which he took care to divide the bone without destroying or interfering with the fibrous expansion in front of it; and, except in one instance, in an old dog, where the union was ligamentous, the division was followed by perfect ossific union. The fibrous expansion, being uninjured, kept the parts in apposition.

6. I had a case in which there was a crucial fracture of the patella in consequence of a contusion from the explosion of a stone in a quarry. The lateral fragments united by bone, the superior and inferior by ligament.

The medium of union is almost uniformly ligamentous: and since the limb is as useful as when the union takes place by bone, and less liable to disruption, bony union being for a long time very susceptible of fracture, it is perhaps the most desirable result.

Treatment.—The principal indications in treatment are to relax the four extensor muscles, to subdue inflammation of the joint, if it should occur, and to keep the fractured surfaces as close as possible together by means of mechanism. Attention to the first indication is essential to the fulfilment of the third. It is of the greatest importance carefully to attend to the period at which it is proper to commence the use of means for the attainment of these three objects: for the first, means should be taken as soon as the surgeon has an opportunity of seeing the injury; for the second, as soon as symptoms of inflammation appear; and for the third, not on any account at first, nor for several days, lest inflammation should come on, which would be aggravated by the pressure; or, if inflammation has already occurred, not until it has subsided. For the purpose of relaxing the muscles, the trunk should be raised to the sitting posture to relax the rectus, the thigh should be bent on the pelvis, and the leg extended on a line with the thigh, having the heel elevated a little, so as to be higher than the knee, but not much raised, lest the position should be painfully constrained. In this attitude the parts of the skeleton, to which the extensor muscles are attached, are approximated.

For subduing inflammatory symptoms of the joint, leeches, evaporating lotions, and purgatives should be employed; and if the symptoms be violent, venesection, antimonials, and low diet, to an extent proportioned to the age and constitution of the patient. While the above remedies must never be withheld when necessary, they ought always to be used as sparingly as possible, otherwise the energy of the reparative powers will be diminished. For preserving the fragments as closely in

apposition as is practicable, various kinds of mechanism are employed, together with the attitude described above. For my own part, I prefer the simple means recommended by Mr. Liston, which I have used in this fracture with as favourable a result as could be reasonably wished. They consist of a simple roller applied from the foot to a little below the knee, to prevent swelling of the leg and foot from infiltration, and a straight wooden splint, hollow at its two extremities and well padded, extending along the back of the limb from a little below the tuberosity of the ischium to a little below the middle of the leg, and retained by a roller, not tightly applied. The fragment of bone connected with the rectus and triceps muscles should be pressed towards the fragment attached to the ligamentum patellæ, before the under part of the thigh is included in the roller. Sir Astley Cooper recommends, as the best mechanism for this injury, a broad leather strap, buckled round the thigh just above the knee, from which a long strap descends, passes under the sole of the foot, and is brought up to a buckle on the opposite side of the thigh belt. The leg is enveloped in a roller, and the limb kept extended by a long splint behind the knee. Mr. Amesbury devised an apparatus for transverse fractures of the patella, which has been called the uniting bandage, and consists of two pieces of leather softly padded on the inner surface, and long enough to pass half way round the limb; these are buckled firmly above and below the patella, by straps passing behind the limb. Two short straps, attached to the lower margin of the upper belt, are brought down one on either side of the patella, and buckled to the upper margin of the lower belt, tightly enough to approximate the opposite edges of the pads, and at the same time the two portions of the patella. A long strap is then carried down the outside of the leg from the upper pad, under the sole of the foot, and up the inside of the leg to meet a buckle on the inside of the same pad. A long splint is then applied to the back of the limb. The plan commonly adopted to bring the fragments towards each other is, to apply a circular bandage both above and below the fractured patella, drawing it together by tapes placed between the bandage and the limb. The tapes are tied over the rollers, and the upper fragment is thus kept down. It has been very justly objected to this common method of treatment,—and the objection applies equally to Mr. Amesbury's, and to some others, which it is unnecessary here to describe, that all belts and bandages tightly applied above and below the fragments must press the extensors attached to the upper fragment towards the femur, and the ligamentum patellæ backwards, so as to sink towards the joint, and thus the upper and lower extremities of the patella are pressed backwards, and the fractured surfaces, instead of being in the same plane, are raised forwards, so as to form an angle with each other. As the under fragment has no tendency to displacement, no advantage whatever can result from pressure below it; but it must be drawn downwards by pressing back the ligamentum patellæ, besides having its broken surface inclined forwards instead of upwards. Mr. Lonsdale has contrived a very ingenious, but rather complicated apparatus, for preserving the fragments in apposition without circular constriction of the limb. A description of it will be found in his excellent work on Fractures. It is of the greatest consequence to

have the medium of union as short as possible; for if it be of great length, there will be proportionate retraction of the muscles, and consequently diminution of their power, and the patient, after his recovery, will not be able to walk quickly without a halt:—hence the importance of preserving the parts as nearly as possible in apposition.

LONGITUDINAL OR PERPENDICULAR FRACTURE.

This injury is caused by direct violence, and may be easily detected by careful manipulation. Progression is difficult and painful, but not impossible, and reunion by bone is readily effected.

Treatment.—The joint is to be kept extended and at rest, the usual precautions to be taken against the occurrence of synovitis, and the ordinary methods to be adopted if it should occur. After all risk of synovitis is over, a slight lateral pressure is to be kept up, which can be conveniently done by pasteboard splints and a roller, or more elegantly by a pad on each side of the patella, and a laced knee-cap. As a precautionary measure, a straight splint should be applied behind the joint.

COMPOUND OPEN, OR EXPOSED FRACTURE OF THE PATELLA.

This is a very serious injury, and always gives rise to the greatest anxiety in the mind of the surgeon, not merely on account of its being open, which is in itself an unfavourable circumstance, but because the patella being a part of the knee-joint, that large articulation is laid open, and the danger is from the synovitis and its consequences, and the great constitutional irritation, which are apt to result. A wound extending into a joint is at all times a serious injury; and when, as in open fracture of the patella, the joint is not only exposed, but the accident is complicated with injuries of the bone and soft tissues, which must give rise to inflammation, the accident is of a very dangerous character. Such injuries often prove fatal in a very short time, and when this happens, it is usually in consequence of violent irritative fever caused by inflammation of the joint. The inflammation of the joint may prevent any opportunity of performing amputation, which should, on no account, be attempted, except after the patient has recovered from the collapse caused by the injury before the inflammation has commenced; or after the active inflammation and constitutional irritation have subsided.

At one time the regular practice was to amputate in all cases of compound fracture of the patella, the limb being sacrificed to save the life; but now many limbs are saved which formerly would have been removed. The circumstances which justify amputation are,—an irritable or debilitated constitution, and more especially, if debilitated in consequence of bad habits, extensive laceration, or severe contusion, or the probability of the occurrence of sloughing of the soft parts. On the other hand, if the patient be of a healthy constitution, and not irritable; if the wound be small, and sloughing not likely to take place, an attempt should be made to save the limb. For this purpose it should be laid at rest in the position proper for fracture of the patella, the edges of the wound should be brought together as speedily as possible, and every means taken to prevent violent inflammation, and to secure adhesion. When inflamma-

tion occurs, it must be combated by the vigorous employment of the ordinary antiphlogistic remedies, namely, venesection, purgatives, antimonials, and low diet, together with the local use of leeches, and either cold or warm applications as may be found most grateful to the feelings of the patient. In all cases in which debilitating remedies are required by the character of the injury or disease, the judicious practitioner will always be careful not to employ them to a greater extent than seems absolutely necessary; but in the treatment of inflammation supervening on fracture of the patella, it is especially necessary for the surgeon to remember, that while it is indispensable to use these remedies to an extent proportioned to the urgency of the symptoms and the age and constitution of the patient, care must at the same time be taken that the strength of the patient be not unnecessarily brought down, otherwise the power and energy of the reparative process will be diminished.

Some patients recover with an anchylosed joint, and others, even after a severe injury, with the perfect use of the limb.

Sir Astley Cooper has recorded five cases which were successfully treated. In one of these the recovery was with an anchylosed knee, and in the other four with the perfect use of the joint. One of the cases, a very fortunate one, occurred in the practice of Mr. Ward, of Nottingham:—although the opening into the joint was large, yet, as the patient was young and of good constitution, and as the tibia and femur, and their cartilages, were uninjured, and the soft parts around the wound were not lacerated nor contused, so that there was little probability that extensive sloughing would take place, Mr. Ward resolved on endeavouring to save the limb, and the patient recovered with the perfect use of the joint, Mr. Ward having afterwards seen him dancing quadrilles at a ball in Nottingham. There is a case recorded by Professor Samuel Cooper, which he saw in St. Bartholomew's Hospital, under Mr. Vincent, where the bone was much fractured and the wound extensive; yet, after the formation of abscesses and the separation of several fragments, the patient recovered with a stiff joint. When I was an apprentice to my friend Dr. Ewing, I had the dressing of a very fortunate case under his care, where, in consequence of the explosion of a stone in a quarry, the patella was broken into several pieces, and the joint extensively opened; but as the person had an uncommonly good constitution, amputation was not performed, and after long confinement and the discharge of a considerable number of small fragments, he recovered with the perfect use of the joint.

FRACTURES OF THE BONES OF THE LEG.

These fractures are very common, as will appear from the following statistics. Dr. George W. Norris, one of the surgeons of the Pennsylvania Hospital, states that during the ten years from 1830 to 1839 inclusive, there were treated in that Hospital nine hundred and forty-six fractures, of which two hundred and ninety-three were of the leg. Dr. Wilkinson King states that of two hundred and twenty urgent cases of fractures admitted into Guy's Hospital in one year, sixty-six were of the leg; and according to Mr. Lonsdale, of one thousand one hundred and one fractures which indiscriminately presented themselves at the

Middlesex Hospital, two hundred and eighty-nine were of the leg. They are the most common of all fractures, except those of the forearm, which according to Mr. Lonsdale and most authorities are somewhat more frequent. There is not entire agreement among surgeons as to the comparative frequency of the different fractures of the leg. According to Baron Boyer they occur in the following order of frequency :—

1. Fractures of both bones.
2. Fractures of the tibia alone.
3. Fractures of the fibula alone.

This order of frequency, given by Boyer, seems to accord with the experience of Professor S. Cooper ; but Mr. Lonsdale found that of two hundred and eighty-nine fractures of the leg, one hundred and ninety-seven were of both bones, fifty-one of the fibula alone, and forty-one of the tibia alone. According to this statement, therefore, the following is the order in which the three classes of fractures of the leg most frequently occur :—

1. Fractures of both bones.
2. Fractures of the fibula alone.
3. Fractures of the tibia alone.

Fractures of the fibula seem to have occurred more frequently than usual in the experience of Dupuytren, who expresses his belief that they are more common than is generally stated, and that fractures of the lower third of the fibula form a third of all fractures of the leg.

FRACTURES OF BOTH BONES.

Fig. 39.



Causes.—These, which form more than half of all the fractures of the leg, are produced in various ways :—sometimes by a heavy body striking or falling upon or passing over the leg, in which case the fracturing cause acting simultaneously on both bones, it is generally found that they are both broken at the same height ; or, by the body falling while the foot is fixed, or by the foot and under part of the leg becoming fixed, while the body is in rapid motion. Another cause of fracture of both bones is a fall or leap from a great height, the person alighting with the extremity extended, and the body erect. The tibia, having to sustain the whole shock, first gives way, and almost always obliquely, and the fibula then receiving the force next becomes fractured. In these circumstances the fractures are not necessarily at corresponding parts of each bone ; for the force being applied to the ends of the bones, each gives way at its weakest part, the tibia frequently about the commencement of its under third, and the fibula within a short distance of its upper extremity.

Symptoms.—The symptoms which denote a fracture of both bones are,—some change in the direction and shape of the limb, pain, inability to walk or sustain

Fig. 39. From a preparation in my museum.

the weight of the body, mobility of the fractured pieces, irregularity perceptible on drawing the fingers along the anterior angle and inner surface of the tibia, crepitus on rotating the foot, and angular deformity on raising up the leg. If the fracture be oblique, the heel may be drawn upwards, and angular deformity may be perceptible in front; the cause of which will be explained, when the position of the broken fragments is described. The manner in which the accident occurred will afford presumptive evidence as to the nature of the injury; but the above are characteristic symptoms.

Nature of Displacement.—The displacement may be longitudinal, angular, or rotatory. The longitudinal displacement producing shortening of the leg, is extremely rare in transverse fracture; indeed, it can scarcely take place, inasmuch as the drawing up of the under fragments is prevented by the upper portions of the bone; but if the fracture be very oblique, the under fragments may be drawn upwards by the muscles of the back of the leg, and thus slight shortening may take place. Angular displacement may be produced by the action of the extensor quadriceps muscle, by the action of the muscles on the back of the leg, or by the weight of the foot; and in each case the salient angle will be in front. When the bones are fractured near the upper ends—a comparatively rare occurrence, which can only take place as the result of direct violence, the upper fragment of the tibia is drawn forwards, there being no antagonist to the quadriceps, which is inserted immediately above the fracture. If the knee be bent, the quadriceps muscle will be put more on the stretch, and thus the upper fragment will be still more drawn forwards; hence arises the great importance, in the treatment of this fracture, of keeping the leg extended. The above is the opinion generally entertained regarding the cause of the displacement forwards of the upper fragment in this fracture, but it is objected to by Mr. C. Aston Key, who remarks, "It is not easy to understand why muscles situated far above the fracture, and sustaining no injury, should be disposed to act on the offensive, while those muscles that act in the opposite direction should be wholly passive on the occasion. It is still more difficult to comprehend, why the extensor quadriceps, lying upon the femur, should be disposed to such inconvenient action as that of per-versely drawing the upper portion of a broken tibia forwards; the site of the fracture having no apparent connexion with the muscles to which the displacement is attributed." He supposes that the muscles surrounding the fracture, becoming distended by infiltration, are thereby put upon the stretch and irritated to contract, and that the lower fragment obeying that contraction is drawn upwards, and thus pushes the upper fragment forwards. The angular deformity may be caused, as has been stated, by the contraction of the muscles on the back of the leg, or by the weight of the foot, and in either case the projection or salient angle is forward. Under such circumstances, the upper or the lower portion of the bone will project farthest, according to the direction of the plane of the fracture. If the plane of the fracture be from above downwards, and from before backwards, the projecting point will be the upper extremity of the lower fragment; if the plane of the fracture be from above downwards, and from behind forwards, the lower fragment

will be drawn upwards by the powerful muscles of the calf, and will push forwards the lower extremity of the upper fragment, which in that instance forms the projecting point. Oblique fractures are very difficult to be managed, and the integuments are very apt to be torn by the projecting points of the fragments. Rotatory displacement, called by some authors derangement in the circumference, arises from the inclination of the foot inwards or outwards, but most commonly in the latter direction.

To avoid repetition, the treatment of all fractures of the leg will be described under one head, after the peculiarities of the other two classes of these fractures have been explained.

FRACTURES OF THE TIBIA.

Causes.—This bone may be fractured by direct violence applied to itself, or by a fall on the foot. The tibia is fractured by a fall on the foot in the same way as the radius by a fall on the hand, and the injury in each instance is most likely to take place if the extremity be extended. As the radius receives on its lower part the whole of the shock from the hand, and on its upper part of the whole momentum of the body from the humerus, in the same way the lower part of the tibia receives from the foot the whole shock, and the upper part receives from the thigh-bone the whole momentum; and as in each instance a single bone sustains the whole shock, it is easy to understand how the radius in one case, and the tibia in the other, may be fractured without a corresponding injury of the ulna or the fibula. In the lower third it may also be fractured by indirect violence, or by what is called by the French, *contre-coup*.

Symptoms.—Since the fibula, by acting as a splint, prevents shortening, or any particular deformity or alteration in the appearance of the limb, and the extent of the fractured surfaces tends also to prevent shortening and displacement, and since the difficulty of moving the fractured portions on each other renders crepitation less distinct than when both bones are fractured, and the patient has sometimes been known to be capable of supporting his body on the injured limb, diagnosis is more difficult in this than in the former fracture. The manner in which the injury was produced, and the pain for some time constant, continuing much longer than that from mere contusion, and increased on moving the limb, are presumptive signs. If the parts be minutely examined, some inequality will be perceived on moving the finger along the anterior angle or inner surface of the tibia; and on taking hold of the ends of the bone and pushing them in opposite directions, some unnatural mobility, and generally slight crepitation also, will be perceptible.

Nature of Displacement.—If the fracture be near the upper end of the bone, the upper fragment will, for the reason before given, be drawn forwards, especially if the knee be bent; but if the foot be kept in a proper position, it is evident, from what has been already said in describing the symptoms, that there will be little tendency to displacement of the fractured portions.

The treatment will be afterwards described.

FRACTURES OF THE FIBULA.

Causes.—Fracture of the fibula in its two upper thirds, while the tibia remains uninjured, can only be the result of direct violence, and the situation of the fracture will be the part to which the violence has been applied. The deep situation of the bone, the manner in which it is covered by the peronei muscles, and its elasticity, allowing it to yield until it receives considerable support from the muscles between it and the tibia, render the bone capable of sustaining a somewhat powerful force directed against its two upper thirds, without its being fractured. The lower extremity of the fibula may be fractured by direct violence, or by the outward or inward twisting of the foot, or by the body falling to either side, while the foot is confined in a deep cleft; as occurred in the case of Sir Astley Cooper, who says, "I broke my right fibula by falling on my right side, whilst my right foot was confined between two pieces of ice, and I could with difficulty support myself to a neighbouring house by bearing on the inner side of the foot." When the fibula is fractured in its lower third by direct violence, the situation of the fracture is the part to which the violence was applied; and when the fracture has been caused by the inversion or eversion of the foot, it is found to be from two to four inches above the lower end of the external malleolus. The fibula is not only useful for affording attachment to muscles, and assisting to form the ankle-joint, but especially, as it has been particularly pointed out by Boyer, for preventing dislocation of that joint, in a forced abduction of the foot. It descends along the outer part of the astragalus, and he remarked that in every step that is made on uneven ground, the foot presses against the inferior extremity of the bone. By this action of the foot on the external ankle, the fibula is pressed upwards, and as the nature of its articulation with the tibia does not allow it to ascend in any perceptible degree, it is compelled to bend more or less in proportion to the force applied. The elasticity of this bone enables it for some time to resume its natural direction, when the force is removed. But as the same force acts frequently, and is never intermitted except for short intervals, the bone insensibly acquires a permanent bend, instead of being perfectly straight, as it is in the infant. The bend becomes more evident in proportion as age advances and the limb has been used. Climbing animals, such as the squirrel, whose feet are always in a very forced abduction, have the fibula very strong; and it has been observed by Cuvier and Dumeril, that in the three-toed sloth, the inferior extremity of the fibula is inserted into a socket on the superior surface of the astragalus in such a manner that the foot must be considerably strengthened by it, and secured against dislocation, by the extreme abduction which this animal is obliged to make in grasping the trunks and branches of the trees on which he climbs.

Of the two causes of fracture of the fibula from indirect violence, namely, violent eversion or inversion of the foot, it is stated by Sir Astley Cooper, Mr. Liston, and Professor Samuel Cooper, that eversion is the more frequent; and in this most surgical authorities seem to be agreed; but Baron Dupuytren, in his experience at the Hôtel Dieu, found inversion

to be more frequently the cause of the fracture. It appears that of two hundred cases of broken fibula, a hundred and twenty arose from inversion or rolling the foot inwards, sixty from eversion or rolling the foot outwards, and twenty from direct violence applied to the bone itself. When the foot is twisted outwards, the weight of the body, instead of following the direction of the axis of the tibia, crosses the lower part of the fibula, the ankle-joint, and the malleolus internus in an oblique direction; so that, under such circumstances, it has to be sustained on the outer side and above the joint, by the under part of the fibula, and on the inner side and below by the malleolus internus, and the internal lateral ligaments, while the under part of the fibula is violently pressed outwards by the astragalus. When fracture is caused in this manner, it is frequently combined with fracture of the malleolus internus, or rupture of the internal lateral ligaments.

When the foot is twisted inwards, the weight of the body, instead of following the long axis of the tibia, passes obliquely across the lower part of the tibia, the ankle joint, and the malleolus externus, the inner aspect of which has the outer part of the astragalus pressed against it, while its under extremity is forcibly drawn inwards towards the outer part of the foot, by the powerful external lateral ligaments:—the rationale of the occurrence of fracture, under such circumstances, may be easily understood.

Symptoms.—There is sometimes considerable difficulty in detecting a fracture in the two upper thirds of the fibula, from the bone being covered with muscles, and there being no shortening of the limb; besides which, the swelling from infiltration often increases the difficulty of tracing the bone, and of detecting crepitus. If the characteristic sign of crepitus be perceptible, either on pressing the bone towards the tibia, or on pressing the foot violently outwards,—by which means it is sometimes discovered, or if another characteristic sign be present, namely, an unnatural yielding, or mobility of the fibula on pressure, there can be no difficulty in forming a diagnosis. In the absence of the above characteristic signs, the surgeon will be guided by the following presumptive symptoms:—the circumstance of the patient having been subjected to the only cause of fracture in this situation, namely, direct force; a fixed pain at the situation of the injury; a crack, or sensation of snapping or giving way of the bone having been perceived at the time when the injury was sustained, and a difficulty in walking, sometimes amounting to inability. Pain at the part is generally increased on pressing the foot outwards.

Fracture of the lower part of the fibula is easily discovered. In addition to the presumptive signs of fracture, the nature of the injury is manifested by an inequality of the bone at the broken part, and unnatural mobility of some portion of the lower end of the fibula; crepitus, perceptible on grasping the leg with one hand, and pressing the foot inwards and outwards with the other; an angular depression at the situation of the fracture; distortion, with some unnatural mobility of the foot from side to side, and a change in the point of incidence of the axis of the limb upon the foot. Many of these symptoms disappear,

when reduction is effected by force applied to the foot, but they return when the force is discontinued.

Nature of Displacement.—In fractures caused by direct violence, or by eversion of the foot, the lower extremity of the upper fragment, and the upper extremity of the lower fragment, are both drawn inwards towards the tibia, so as to diminish the interosseous space; but in fractures caused by violent inversion, while the lower extremity of the upper fragment is drawn inwards, as in the other varieties, the upper extremity of the lower fragment is drawn outwards, partly from the manner in which the fracture is produced, and partly from the lowest part of that fragment being kept inwards by its attachment to the outer side of the foot by the external lateral ligaments. A fracture caused by inversion is usually nearer the malleolus externus, than one occasioned by eversion.

TREATMENT OF FRACTURES OF THE LEG.

All fractures should be reduced as quickly as possible. To make the description of the treatment of these fractures more clear, they may be divided into two classes:—first, fractures, whether of the tibia, or of both bones, in the upper third; and secondly, fractures of either or both bones, below the upper third.

I. In fractures of the tibia, or of both bones, which occur in the upper third, or even nearly as far down as the middle of the leg, the pelvis should be raised, and the limb placed in a straight position. If the leg be bent, the quadriceps muscle, by being put on the stretch over the articulation, will cause the under part of the upper fragment of the tibia to press against the common integument; and if this should not be obviated, there will be great risk of a simple becoming an open or compound fracture, by ulceration of the integument. In this class of fractures, therefore, the straight is the preferable attitude. The necessary appliances are very simple, and consist merely of a roller to the foot and lower part of the leg, to prevent swelling from infiltration; a hollow straight splint of wood, extending from the middle of the thigh to near the heel, and two pasteboard or gutta-percha splints for the sides of the leg, together with a bandage for retaining the splints in their proper place.

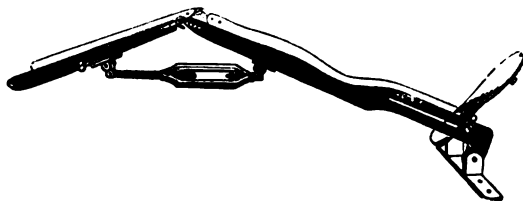
II. In fractures of either or both bones below the upper third, the treatment must be different, both as regards attitude and mechanism.

Attitude.—The preferable attitude, is that in which the leg is bent on the thigh, the degree of flexion being greater or less, as is found most conducive to the easy retention of the fragments in apposition, and in their proper relations to each other, the foot being very slightly extended, and neither inverted nor everted. In this attitude, it will be more easy than in any other, to prevent the various kinds of displacement formerly described.

Mechanism.—Various kinds of mechanism have been invented for the treatment of these fractures. The double inclined plane of the late Mr. M'Intyre of Newcastle, is an ingenious, elegant, and excellent apparatus, and so also is that of Mr. Amesbury, and by means of either of them, all the indications to be fulfilled by mechanism, can be readily

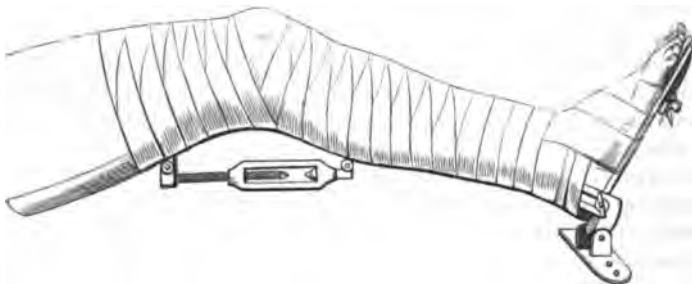
accomplished ; but a much cheaper and equally useful apparatus, is the splint recommended by Mr. Liston, than which a more convenient piece

Fig. 40.



of mechanism for the purposes for which it is intended, could not be desired. It consists of a foot-board of wood, and leg and thigh pieces of sheet iron joined to each other by a couple of hooks and a screw. The screw was in use centuries ago, and is represented in the surgical works of Jerome of Brunswycke, published in the sixteenth century. By it the thigh and leg pieces may be set to any angle, at which it may be desirable to bend the knee, and the foot-piece may be moved upwards or downwards, to suit the length of the limb, and fastened by a side screw, in any position that may be desired. The splint having been

Fig. 41.



adjusted and well padded, the pads being secured by bits of tape, and a sock with a piece of tape opposite to the ball of the great toe, having been put upon the foot, the limb is placed on the apparatus, and the piece of tape attached to the sock is fixed to a knob on the surface of the foot-board. The broken ends of the bones having then been placed in perfect contact, and in the desired position, the foot, leg, and thigh should then be secured by a roller commencing at the toes, and carried up so as to embrace the whole of the extremity and apparatus, and also to make some turns round the loins. This will prevent the danger of displacement from any slight motion of the trunk, and although the whole extremity may be moved as one piece, the fragments will always preserve the same relations to each other. The bandage should be made to pass between the screw and the apparatus, and in carrying it round the limb, the greatest care should be taken to adapt it neatly by

Fig. 40. Liston's cradle.

Fig. 41. Liston's splint applied.

reverses, where inequalities of the limb would cause it to lie unevenly. For favouring the return of blood, and diminishing the danger of swelling, the extremity should be raised a little above the level of the trunk, while the patient remains in bed. In general, it is unnecessary to confine the patient for more than eight or ten days; after this he may be allowed to sit up during most of the day, with the heel on a level with the pelvis. The treatment thus goes on pleasantly, without danger of the general health being injured by long confinement to bed. By occasionally turning the screw very slightly, passive motion is given to the knee, and the danger of stiffness is obviated. In six or eight weeks, as consolidation has advanced, the time for which varies according to the age, strength, and constitution of the patient, the apparatus may be removed, and the patient allowed to move on crutches: he must be careful, however, not to put any weight on the limb for several weeks, otherwise, however straight the leg may be, on the removal of the apparatus, it will become bent and deformed. After the removal of the apparatus, gentle support should be given to the leg by means of the starched bandage, or by pasteboard splints and a common roller. A more convenient or successful method of treatment than the above, need not be desired.

In the absence of the more perfect apparatus, the fragments may be preserved in their proper relations to each other by means of the common wooden splints for the leg, retained in their position by loop or buckle bandages. In fractures of both bones, each splint should have a foot-piece; but in fracture of a single bone, it will be sufficient if a foot-piece be attached to the splint on that side to which the foot has a tendency to turn. The splints should be well padded with wadding, cotton-wool, or tow, to prevent painful pressure on the soft parts.

[Perhaps the simplest apparatus for fractures of both bones of the leg, with the exception of those occurring in the lower third of the fibula, is the *fracture-box* which is used in the Pennsylvania Hospital.

It consists of a long, narrow box, reaching from above the knee to the sole of the foot. The sides are movable, being attached by hinges to the bottom, and the end of the box is longer than the foot, and answers for a foot-piece. The sides of the box are to be opened, and a small pillow laid on the bottom, which, when the sides are closed, answers the purpose of junk or bran bags, adapting itself to the inequalities of the limb. The foot is to be secured by a bandage to the foot-board. The pressure required to retain the coapted fragments can be regulated by tying several tapes more or less tightly around the box.—ED.]

Fractures of either malleolus, or of a single bone, near its lower extremity, can be conveniently treated by the simple apparatus so strongly recommended, and successfully employed by Baron Dupuytren. When slightly modified, it consists of a straight wooden splint, a pad, thicker at the end nearest the ankle, and a roller. The splint should be long enough to extend from the head of either bone of the leg to three or four inches beyond the foot, and have two retiring angles or notches at its extre-

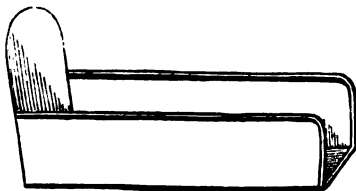


Fig. 42.

mity, and perforations at its upper end to admit pieces of tape, by which a pad is affixed to it, and also to receive the split end of the roller. It should be applied to the side of the leg opposite to that to which the foot has a tendency to turn, the one extremity extending upwards to near the knee-joint, the other to three or four inches beyond the foot. The pad should be between the leg and the splint, with its thicker end between the latter and the foot; and the roller should be fixed to the upper extremity of the splint by passing the two parts of

Fig. 43.



its split end through the perforations, and securely fastening them together. This will prevent the splint from being pressed upwards. The roller then, embracing the leg and splint from above downwards, should, during its convolutions round the foot, be made to pass through the retiring angles or notches in the extremity of the splint, whereby it will keep the foot from being displaced in the direction in which it is turned by the accident, and the thick end of the pad acting as a fulcrum, and keeping the splint removed from the foot, will enable the bandage to act with greater effect. In this method of treatment suggested by Baron Dupuytren, the bandage offers the resistance to displacement of the foot, and the splint should always be placed on the side opposite to that to which the foot has a tendency to turn; whereas, in the treatment with the common splints for the leg, which some British practitioners still employ, the splint with the foot-piece offers the resistance to displacement, and it should always be on the side to which the foot is displaced. In the latter method the resistance to displacement is offered by the splint with the foot-piece, in the former by the bandage; in the latter the splint with the foot-piece is always applied to the side to which the foot is displaced, in the former the single splint is always placed on the opposite side.

A most satisfactory way of treating simple fractures of the leg is by means of pasteboard splints, together with starch bandage, or by starch bandage alone. The period for application is after the subsidence of the swelling and slight inflammation that usually follow the injury. A great advantage of this method is, that such an incasement is formed round the limb as serves to remove all danger of displacement, and makes it unnecessary to confine the patient for any great length of time to the recumbent posture. Nothing could answer better than this mode of treatment, when resorted to at the period mentioned above.

Fig. 43. From Liston.

Of the practice, recently adopted in Belgium, of applying the starch bandage immediately after the occurrence of the injury, and thus forming an incasement for the limb, I have had no experience; but the results are said to be satisfactory, and individuals who have in that country witnessed this mode of treatment have given very favourable accounts respecting it.

OPEN OR COMPOUND FRACTURE OF THE LEG.

Compound fracture of the leg is more frequently met with than any other kind of compound fracture. If portions of bone be completely detached, they should be removed; and if the extremity of a fragment project through the wound in the soft parts, it should be reduced; but no general rule can be given as to any uniform mode of reduction. Sometimes it may be best accomplished by enlarging the wound in the soft parts, sometimes by cutting off a portion of the projecting bone with a saw or cutting pliers, and occasionally it may be necessary to employ both these methods to a certain extent. The surgeon should in every instance be guided by the particular circumstances of the case; but in general, if the projecting part of the bone be short and of considerable thickness, the more judicious procedure is to enlarge the wound; whereas if it be a long slender portion, it would be more advisable to cut part of it off. It is only, however, when reduction cannot be otherwise accomplished, that the surgeon should have recourse to either of these plans. The wound should be cleaned, and its edges brought together, and dressed as the circumstances may suggest; pressure on the part should be carefully avoided, and if abscesses form, they should be opened without delay. The local and constitutional treatment must be regulated according to the symptoms at the time.

FRACTURE OF THE RIBS.

Fractures of the ribs happen almost as frequently as those of any other bone in the body. From the statistics of Mr. Lonsdale, it appears that, out of one thousand nine hundred cases of fractures admitted into the Middlesex Hospital, thirty-five were fractures of the ribs. The middle ribs being the longest and most exposed to violence, are most liable to fracture. The upper ribs being the strongest, and protected by the clavicle and the pectoral muscles, are rarely fractured. The lower ribs generally escape injury in consequence of their being short, mobile, and free at their anterior extremities.

Exciting causes.—This accident is produced in one or other of three ways:—either by direct violence, as a blow, or fall; or by the application of force to the sternum or anterior extremity of the rib; or by muscular action, as in coughing, in persons of a cachectic habit of body. If a rib be fractured by direct violence, the part where the violence was applied, is the site of the fracture. If the second exciting cause mentioned produce fracture, the rib gives way at its most convex point—a little anteriorly to its angle.

Symptoms.—A fracture of a single rib, unattended with any internal lesion, is an injury of little moment, the patient commonly recovering in the course of four or five weeks; but when several ribs are broken,

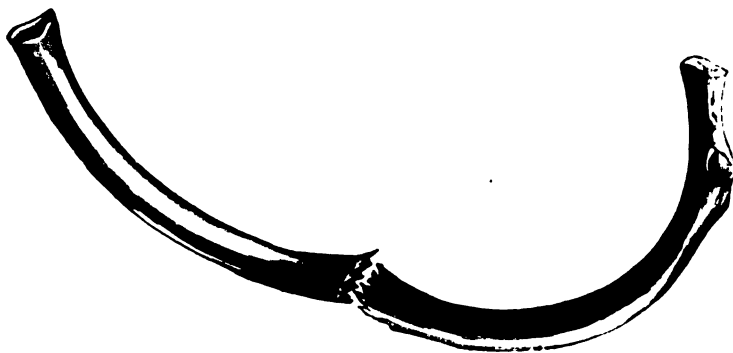
and there is, connected with the injury, one or more of the complications hereafter specified, the case is one of a very serious nature, and such as often terminates fatally. A simple fracture is often capable of detection by merely passing the finger over the suspected part. The more elegant mode of examination, is to place the hand upon the injured part, and to desire the patient to make a full inspiration, or to cough; when, if a fracture be present, a crepitus will be perceived, and the patient will experience great pain, from the ends of the bone grating upon the soft parts. This latter symptom is much increased by any exertion of the respiratory organs, as sneezing, coughing, &c.

Absence of Thoracic Respiration.—On account of the pain which attends the motion of the rib, the patient avoids thoracic respiration, and calls into action the diaphragm and abdominal muscles.

Fig. 44.



Fig. 45.



Nature of Displacement.—It is necessary to attend to the direction of the salient, or pointed angle. It is obvious that the displacement of the ends of the fractured rib can only be either inwards or outwards, for the intercostal muscles preclude the possibility of their assuming an upward or downward direction. If a rib has been fractured by direct violence, the direction of the retiring angle will be outwards, and of the

salient angle inwards; on the contrary, if the injury has been produced by violence, applied to the sternum or anterior extremity of the rib, the direction of the retiring angle will be inwards, and that of the salient outwards: in fact, the disposition of parts is just the reverse. The former kind of displacement is the more dangerous, because the pleura and lungs are apt to be wounded. If there be a mere fissure, there is no displacement.

Treatment.—This consists in keeping the rib at rest as much as possible, by means of a broad bandage of calico or flannel, applied round the chest so tight as to stop thoracic respiration, and to make the diaphragm and the abdominal muscles aid in the performance of the respiratory action. If the ends of the fracture project into the cavity of the chest, a large compress is to be applied in front of the sternum, and in this manner the convexity of the rib is increased. If they incline outwards, the modification of the treatment consists in placing two large compresses, one on each side of the fracture. It is convenient, in order to prevent the broad bandage from slipping down towards the loins, to attach a split cloth, or a scapulary, to its central part posteriorly, and, passing it over the shoulders, to secure it in front. Instead of the bandage already described, a belt of webbing or girth, furnished at one end with four or five buckles, and at the other with as many straps, as also with two shoulder-straps to prevent displacement, is sometimes employed to suspend the movements of the chest in respiration. It is more compact and effective than the common bandage, and is called a fractured rib bandage. To prevent the occurrence of inflammation within the chest, it is expedient, if the patient be very plethoric, to take blood from the arm.

PARTICULAR COMPLICATIONS.

GENERAL EMPHYSEMA, or inflation of the subcutaneous cellular tissue of the body.

Symptoms.—These are,—difficulty of breathing, a preference of the erect attitude to the horizontal, great distension of the cellular membrane, pitting and crackling on pressure of the swelling, and, if the emphysema be very great, a hissing noise on cutting the skin, arising from the escape of the air.

Condition of Parts.—Rupture of the pleura and a portion of the lung, from the ends of the fractured rib projecting into the cavity of the chest, is necessary to produce this condition. The air is effused into the chest, escapes into the cellular tissue around the fracture, and by the contraction of the chest in respiration is forced into the general cellular tissue, because the air has no outlet, the skin being entire. We say, therefore, that general emphysema, in fracture of the ribs, is the result of an unnatural communication between the air-cells of the lung and the cells of the subcutaneous cellular tissue. If this condition prove fatal, it is by way of asphyxia, the great distension of the cellular membrane mechanically compresses the thorax, so that the muscles of respiration being overpowered are incapable of dilating the chest. The difficulty and imperfection of respiration are indicated by the lividity of

the face, lips, and eyelids, the dilatation of the nostrils, and the coldness of the extremities for some time previous to dissolution.

Treatment.—A few deep scarifications should be made over the sternum and the ribs, when the air will escape, and the swelling gradually disappear.

PNEUMATHORAX, or accumulation of air sent from the air-cells of the lung into the cavity of the pleura.

Symptoms.—In a well-marked case, on looking at the thorax, it will be observable that the affected side of the chest is longer, from the ribs being more or less separated, larger, circular, and almost motionless during respiration. Auscultation supplies another symptom, namely, the complete absence of the respiratory murmur, except at the roots of the lungs, that is, between the scapula and the spine.

On percussion the affected side yields a clearer sound than the other. This symptom, together with the greater size of the affected side, might lead one to consider that as the sound, and the healthy as the diseased side.

Treatment.—Generally a slight degree of inflammation takes place, which seals up the air-cells, and the air is absorbed. The circulation of the lungs should be kept as low as possible, and antiphlogistic remedies had recourse to. Sometimes, however, the operation of paracentesis is necessary.

INTERLOBULAR EMPHYSEMA, or infiltration of air into the cells of the cellular tissue of the lung.

Condition of Parts.—This affection is produced by rupture of some of the proper air-cells, and the consequent extravasation of the air contained in them into the cells of the cellular substance of the lung. The cells of the cellular tissue thus distended with air compress the air-cells and vessels of the lung, in consequence of which the circulation of air through the air-cells, and blood through the pulmonary vessels, becomes interrupted, and the portion of lung is rendered incapable of performing its function. The air in the cellular tissue does not undergo change; consequently it can have no beneficial effect upon the blood in the lung, and by means of the distended cellular tissue, septa form, which isolate a portion from the rest of the lung. These septa, by rasping against the parietes of the thorax, produce the friction of ascent and that of descent, which are indicative of this condition of lung.

Symptoms.—On exposing the thorax we observe, that the affected side is less movable during respiration, not contracting and dilating as in the normal state. If the affection be very great there will be a slight increase in the length and size of the affected side.

On percussion over the site of the emphysema, the chest sounds somewhat more clearly than natural, but not to such extent as in pneumothorax. The nearer the injury is to the surface of the lung the more distinct the resonance will be. Auscultation furnishes another sign completely pathognomonic of this affection, namely, the crepitus ronchus with large bubbles. This sign, which is more marked during inspiration than expiration, resembles the noise produced by filling a dried bladder with air. Connected with this sign we usually perceive the friction of ascent, and the friction of descent, the former accompanying

inspiration, the latter taking place during expiration. The impression communicated to the ear is that of some hard dry body, rising and falling, and rasping against the thoracic parietes, and is particularly discernible just as expiration ends, and before inspiration commences. Sometimes this sound is perceptible in the under part of the thorax in the neighbourhood of the diaphragm, sometimes in the situation of the mediastinum. In some instances this sound is continuous during inspiration and expiration, in other cases there is a succession of sounds. Besides the symptoms already mentioned, there are others of a general and local kind, as dyspnoea, more particularly on making any exertion, slight lividity of the countenance, coldness of the extremities, and occasionally emphysema.

Treatment.—This affection is attended with danger, and all that can be done is to preserve the circulation of the lungs as quiet as possible. With this view, lay the patient in bed, enjoin low diet and the usual antiphlogistic remedies. Sometimes nature seals up the cells with lymph, and the air is absorbed and the cellular substance surrounding the lobules assume their healthy condition.

HÆMATHORAX, or effusion of blood into the cavity of the pleura from rupture of some of the intercostal vessels, and perhaps of those in the substance of the lung.

Symptoms.—Impeded respiration from obstruction to the motion of the lungs, is one of the most marked symptoms of this affection.

Percussion yields the dull sound, from blood being interposed between the thoracic parietes and the lung. The stethoscope indicates the absence of the respiratory murmur, except at the root of the lung; and before the effused blood be coagulated, there is sometimes heard a silvery sort of echo of a sharp and shrill tone, termed ægophony, the impression communicated being that of a voice heard within the thorax. The voice is reverberated in the bronchial tubes, and is conveyed to the surface of the chest by the compressed lung and the extravasated blood. The presence of a fluid seems to be one of the most essential conditions for the production of this phenomenon, consequently it can exist only before the blood is coagulated. The features become pale, and all the symptoms of internal hemorrhage appear.

FRACTURE OF THE STERNUM.

The sternum is sometimes fractured, but not so often as might be expected from its exposed situation. It is enabled from its position between the elastic cartilages of the ribs to avoid any ordinary violence. A fracture of the sternum is sometimes followed with serious consequences, as necrosis, or abscess immediately behind it.

Symptoms.—This injury is easily detected by the crepitation which is felt on applying the hand to the front of the chest, and desiring the patient to make a full inspiration. The function of respiration is principally performed by the diaphragm.

Treatment.—The patient should be placed in bed, with the head bent forwards and the pelvis slightly elevated in order to relax the sternomastoid and the abdominal muscles. If this be not attended to, an angular deformity, having the salient angle directed forwards, will result.

With the view of keeping the fragments at rest as much as possible, some apply a large soap plaster over the ribs, others employ a broad bandage, as in fracture of the ribs, which is unquestionably the right proceeding.

FRACTURES OF THE PELVIS.

These are of rare occurrence, on account of its peculiar shape and the great thickness of several of its bones.

Exciting Causes.—Falls from a great height upon the pelvis, the passage of heavy bodies, as a cart or wagon over it, and falls from or under a horse, are the ordinary exciting causes. Of three cases I have seen, one was produced by a fall over the ballusters of a staircase from the second to the ground-floor; a second arose from a fall from an embankment upon a heap of stones; and the third was a complicated case, in which there was dislocation of one of the thigh-bones produced by an explosion. Fractures of the ossa innominata, especially if deep-seated, are with difficulty detected, but the nature of the injury can generally be ascertained from the history of the case, and the inability of the patient to support himself in the erect position. There is also a feeling of laceration at the seat of the injury on the patient making any exertion.

It often happens as a serious consequence of fractures of the pelvis, that the bladder is lacerated and the urine escapes. If the laceration be in particular situations, the urine escapes into the peritoneum, speedily producing peritoneal irritation and death; and at other times, and more frequently, the urine is effused into the cellular tissue about the pelvis, giving rise to sloughing of the parts and extensive abscesses. Fracture of the sacrum is often attended with compression of the sacral nerves, and consequently with paralysis of the lower extremities. Fracture of the os coccygis can be ascertained by careful manipulation, or by introducing the finger into the rectum, by which means apposition of the parts may be also produced.

Treatment.—With respect to treatment of fractures of the pelvis, one precaution never to be delayed, is the introduction of a catheter into the bladder, which should be allowed to continue there a considerable time, in order to diminish the danger of extravasation. The patient should be placed in a very soft bed, in the easiest position, and the lower extremities tied together to prevent any motion.

If inflammation succeed, it must be combatted by the strictest antiphlogistic treatment the powers of the patient will permit, and after some time a broad belt may be placed around the pelvis, so as to keep the parts at rest.

In the union of a fracture of the sacrum, there is sometimes a considerable quantity of callus thrown out, which may prove inconvenient.

FRACTURES OF THE SPINE.

It very rarely happens that one vertebra is broken: two or more are generally involved in the injury. The vertebral column contains and protects the spinal cord, which gives off the nerves that preside over sensation and voluntary motion.

Exciting Causes.—These are two: direct violence to the vertebral column, and falls from a great height upon the head, the head being at

the time bent forwards. When the latter is the exciting cause, the appearance presented by the spine is the same as in excurvation, or posterior curvature of the spine.

Symptoms.—These vary very much, and depend upon the situation of the fracture and its effects upon the spinal cord. If a fracture take place in the lumbar region, and if, in addition to the fracture, there be pressure upon the spinal cord, arising from displacement, effusion, or extravasation, there will follow loss of sensation, involuntary expulsion of the fæces, retention of urine, together with a sense of pain and weakness, and a degree of irregularity at the seat of injury. The inability of the patient to retain the fæces arises from the sphincter muscle, which receives its nerves from the spinal cord, being paralysed.

Rationale of the Retention of the Urine.—The bladder being paralysed cannot pass off the urine; hence the retention. This retention of urine, as pointed out by Desault, if the patient do not die, is followed by a sort of dribbling, or incontinence of urine.

The explanation of this latter circumstance is, that the bladder becomes so enormously distended, that the urine forces open the commencement of the urethra to such an extent as to allow a small quantity to dribble off, yet not sufficiently to relieve the retention or obviate the necessity for the introduction of a catheter. A symptom which occasionally takes place at the time of the injury, is priapism, and even emission of the semen, which Mr. Lawrence remarks, has never been satisfactorily explained. Notwithstanding the presence of these symptoms, the functions of organic life, as heat, secretion, and circulation, still continue. If a fracture with compression occur at the upper part of the lumbar region, the whole of the symptoms already mentioned will be observed, with the addition of a tympanitic condition of the abdomen, produced by the sudden distension of the intestines with gas. If the patient do not soon die, this symptom sometimes disappears after a smart purging. If a fracture happen in the upper part of the dorsal region, together with pressure upon the spinal cord, the additional symptom is, absence of thoracic respiration, arising from pressure upon the spinal cord above the origins of the intercostal nerves.

If the fracture be as high up as the sixth cervical vertebra, and attended with pressure upon the spinal cord, there is paralysis of the superior extremities.

When a fracture, attended with compression of the cord, takes place above the third cervical vertebra, it is instantly fatal. The phrenic nerves supply the diaphragm, and instant death is the result of pressure upon the spinal cord above their origins. The period at which the patient dies, varies according to the different situations of the accident, and the extent of pressure upon the cord.

Death is not the immediate result of fracture, even above the third cervical vertebra, unless it be attended with displacement. When a fracture is lower down, between the fourth cervical and the first dorsal, the patient generally lives from three to ten days. When the dorsal region is the seat of fracture with compression, the patient may live from two to three weeks. If a fracture occur in the lumbar region, the

patient may perhaps live from three to eight weeks, occasionally some months, as in a case recorded by Mr. Harold, of Cheshunt.

Treatment.—Little can be done. The patient should be placed in the easiest attitude, and the broken ends of the column preserved at rest. Antiphlogistic treatment, both general and local, especially local depletion by leeches, may be necessary to prevent and subdue inflammation. The state of the bladder must be particularly attended to, and the catheter introduced, if necessary. If the immediate effects are not fatal, counter-irritants may be locally applied, but their use should be delayed for some time.

Concussion of the spinal cord may lead an individual to suppose that compression exists when it really does not. Here counter-irritation in the chronic stage is very beneficial. The application of strychnine is then often attended with the happiest results. The best mode of using it is to apply blisters, about the size of a crown-piece, and, when the cuticle is removed, to throw one quarter or one half a grain of the powder of strychnine over the blistered surface. The operation of trephining for the purpose of removing pressure from the spinal cord, has been proposed and performed: success, however, does not seem to have attended the operation, or to encourage a repetition of it. Upon this point Sir A. Cooper remarks, "Mr. Henry Cline was the first person who attempted to give relief in this accident. Being an excellent anatomist and a most able surgeon, he saw no reason why cases of this kind should not be treated as cases of fracture with depression of the skull. Accordingly he cut down upon the arch of the spinal marrow, where the compression was greatest, and with a small trephine of his own invention, he sawed through the arch of the spinous process, and took off the pressure on the spinal marrow by raising the depressed portion of the arch.

"It is well known that in cases of fracture, where the displacement has been slight, union of the bone has been produced. There would be no difficulty in producing this union, supposing the pressure on the spinal marrow to be removed. There is a preparation in Mr. Brooks's collection, from a case of fracture with depression, where the person lived long enough for the fracture to be united; and in the College of Surgeons there is a preparation, presented by Mr. Harold of Cheshunt, from a case where union of the bone took place after fracture with displacement. There is no danger, therefore, as to the restoration of the arch of the bone, if the pressure on the spinal marrow could be removed; and it was with this view that Mr. Cline sawed through the arch. It is right, however, to mention that, in many of these cases the spinal marrow is itself torn through. In some cases of fracture, with displacement, it is completely torn; in others, partially, and in some not at all. In cases where it has not been torn, there would be hope from such an operation; and it is in these cases that the operation has been performed. Mr. Tyrrell has attempted the operation since Mr. Cline; but both cases have terminated unfavourably. Whether future experiments may be attended with better success, it is impossible to say. The proposal was plausible; the operation was easily performed; and as to the result if the spinal marrow were not torn, there seems no reason why a person

should not recover after such an operation. We are obliged, however, to speak doubtfully on this subject, since the first experiments have been unsuccessful. If you could save one life in ten, ay, in a hundred, by such an operation, it is your duty to attempt it, notwithstanding any objections which some foolish persons may have urged against it. Suppose any one present were in this state himself; suppose him put to bed with a paralysis of his lower extremities, and fully acquainted with the inevitable result if nothing were done; would he not be glad to have an attempt made to save him? Would it not be foolish and unmanly to say he would rather die than have such an attempt made? The operation is not severe; it cannot add to his danger; and as to the pain, no man is a man who would regard it. In the two cases in which the attempt was made, the operation did not shorten life; on the contrary, there is reason to believe that it prolonged it. You will be justified, therefore, in making the attempt. Though I may not live long enough to see the operation frequently performed, I have no doubt but it will be occasionally performed with success. There is no reason why it should not; and he who says that it ought not to be attempted is a blockhead."—Sir A. Cooper's *Lectures on Surgery*, pp. 152, 153.

"It has been proposed," Mr. Liston observes, "to treat the spine, in cases of severe and alarming fracture, in the same manner as the cranium, by trephining; and some have recommended this in almost all kinds of injuries. I allude to the practice, only to condemn it. The spinal cord is generally displaced and compressed by the lower portion of the fractured body of the bones. One cannot easily comprehend what an operation is to effect in such cases: further notice of this proceeding is unnecessary, seeing that, as far as I know, it has been unanimously discarded by the profession from amongst the list of surgical operations."—Liston's *Elements of Surgery*, second edition, p. 697. "The great objection," says Mr. Lawrence, "to this proceeding is, the uncertainty respecting the precise seat of injury, and the precise mode in which the spinal cord has been injured, or continues to suffer pressure. This operation of exposing and taking away part of the vertebral column, is really a very serious, and I may say, a very delicate affair; it is an operation which, if it were done when the contents of the spinal canal were perfectly uninjured, would, I think, be likely to be followed by inflammation of the membranes and cord; it would be likely to produce mischief, even if no mischief had existed before. For these various reasons it appears to me that the proposal of taking out the spinous processes of one or two of the vertebræ ought not to be entertained."

CHAPTER VI.

INJURIES OF THE HEAD.

FRACTURES OF THE CRANIUM.

Causes.—From the manner in which the different bones of the cranium are arranged, an ovate or spheroidal box is formed, which resists external violence, after the manner of arches, according to Bertin, and of spheres according to Béclard; yet it is frequently fractured, and in the majority of instances these fractures are produced by the direct application of force to the injured part, as when a person is struck, or falls upon the head, and the bone is broken exactly where the blow or fall was inflicted. The cranium, however, does not always give way where it was struck, but sometimes at a distant part, forming the *fracture by counter-stroke* of the British, the *fracture par contre-coup* of the French authors.

Fractures of the base of the cranium, in the great majority of instances, are caused by counter-stroke; the reason of which is easily explained. If a great weight fall upon the top of the head while the body is erect, or if the top of the head be struck by an obtuse body, the force thus applied above has a tendency to produce expansion of the lateral parietes, and to force the base of the cranium against the apex of the spinal column. It is evident that in such circumstances the cranium is acted upon by two forces: the violence applied to the top of the head acting downwards, and the resistance offered by the vertebral column acting upwards, so that a fracture

of the base is often the result. In like manner, when in falling from a great height, the top of the head or vertex comes to the ground, the resistance of the ground acts on the top of the head, and the whole momentum acts through the medium of the spinal column on the base. The cranium, being thus included between two forces, gives way at its weakest part, that part being the base. Sometimes, however, fractures of the base are produced without a fall or blow on the head itself, as when a person falling from a great height alights upon the nates; the spinal column being thus brought suddenly into a state of rest, offers

Fig. 46.



Fig. 46. Fracture across whole base of the skull, produced by a fall on the crown of the head. The patient was admitted into my wards in the Royal Infirmary. From a preparation in my museum.

resistance to the head, which being still in projectile motion, has its base forcibly driven against the spine, and a fracture may be the result. In each of these three cases, the head is acted upon by two forces with greater or less violence.

Sir Benjamin Brodie, in a very interesting paper on Injuries of the Brain, in the fourteenth volume of the *Medico-Chirurgical Transactions*, says at p. 329,—“It has been observed to me, however, by Mr. Earle, that he has not known a fracture of this kind (*i. e.* by counter-stroke), to take place, except when the blow seems to have operated in such a manner as to impel the occiput forcibly against the atlas, the line of fracture passing through the former bone, where it rests on the latter. My own experience corresponds very nearly with that of Mr. Earle. The only well-marked cases of fracture of the cranium, in which the fracture could be attributed to the effects of *contre-coup*, which have fallen under my observation, were similar to those he has mentioned. I do not, however, mean to assert that such fractures absolutely never occur, independent of the reaction of the atlas. Among the cases recorded in the *Prize Memoirs of the French Academy of Surgery*, there are some which show that the thing does happen; and Mr. Bell has afforded an ingenious and scientific explanation of the mode in which it happens. It is, however, worthy of remark, that the only two cases which Mr. Bell has adduced in illustration of what he has advanced, are those in which the fracture extended across the occiput, in the one passing through, in the other close to the *foramen magnum* of that bone.”

Fractures of the base of the cranium are not invariably caused by *counter-stroke*. Sometimes, when violence is directly applied to the occiput or the lateral parts of the cranium, it is not only sufficient to produce fracture of the part to which it is applied, but also to extend the fracture to the base. Of this I have seen two instances:—one, in which the fracture extended forwards to the body of the sphenoid bone, in consequence of a fall on the occiput, and the other, in which it extended along the whole base of the skull, in consequence of a kick from a horse on the mastoid process.

Of fractures of the cranium it may be observed, that those of the base in most instances result from counter-stroke, while those in other situations are invariably occasioned by direct violence.

ARRANGEMENT OF FRACTURES OF THE CRANIUM.

These fractures present every possible variety of form, from the most simple fissure to the most complicated fracture extending in many directions, and accompanied with depression. The ancient writers divided fractures of the cranium into many different varieties, distinguishing each by an appellation descriptive of its form, or of some peculiarity in the relation of the fractured parts; but these appellations, as they burdened the memory without leading to any useful practical results, are now abandoned. To show clearly the views now entertained respecting the nature and treatment of these injuries, it will be convenient to arrange them in the following six classes. First, Simple fissure, or fracture unattended with depression. Second, Simple fracture with

depression. Third, Punctured fracture. Fourth, Compound or open fracture. Fifth, Fracture of the external table alone; and Sixth, Fracture of the internal table alone.

I. SIMPLE FISSURE, OR FRACTURE UNATTENDED WITH DEPRESSION.

As in this injury there is no wound in the soft parts, and the broken pieces preserve their proper level or equality of surface, and as the simple interruption to continuity of the bone produces no symptom denoting its presence, it often escapes detection, and continues during life a matter of uncertainty. Simple fracture, considered in itself, is by no means a dangerous injury, and when its existence is suspected, and there is no accompanying injury of the parts within the cranium, it is not necessary to do more than enjoin every prudent precaution against the occurrence of inflammation. The violence which breaks the bone may

Fig. 47.



give rise to separation of the dura mater, laceration of the brain, extravasation of blood within or upon the brain, or above or below the dura mater, or to simple fissure of the outer table and fracture with depression of the inner; and in consequence of some of these accompanying conditions within the head, there may be concussion immediately after the

injury, or the symptoms of compression or of inflammation of the brain or its membranes may appear, with all their usual consequences, to a dangerous or even fatal extent. The treatment of these conditions will be afterwards described.

II. SIMPLE FRACTURE WITH DEPRESSION.

The local signs of this injury are,—an inequality of the surface of the cranium, varying in extent according to the amount of depression, and usually the appearance of a bruise of the scalp. Sometimes the fragments are movable; in other instances the depressed portion is quite unyielding. There is a condition of scalp, frequently presenting itself after a contusion, more especially if inflicted by a flat body, which is very deceptive, and apt to make the inexperienced observer suppose that the depression of bone is to a much greater extent than it really is, and even to produce the impression that the bone is driven in, when no fracture really exists. I refer to the swelling caused by extravasation. Into the cellular tissue surrounding the contusion blood becomes extravasated, and this raises up the soft parts to a considerable extent, whereas, at the bruise itself, if the contusion has been severe, the soft parts remain compressed in consequence of the cellular tissue having been deadened and the vessels paralysed by the bruise. The swelling

Fig. 47. Simple fissure of cranium, produced by a fall on the side of the head. The case occurred in the experience of my colleague, Dr. Dyce. From a preparation in my museum.

is remarkably firm, and the impression given to the finger by the extravasated blood so closely resembles that given by the margin of a fractured portion of bone, that it is very likely to deceive an unguarded observer. This condition of the soft parts should be always kept in mind, lest the surgeon be deceived, either into the supposition that there is depression where none exists, or into the opinion, when it is present, that it is to a greater extent than is really the case. If the injury be not inflicted by a flat body, the whole of the scalp may be elevated at the injured part. Extravasation may be found in three different situations, namely, between the integument and the tendon of the occipito-frontalis muscle, between the occipito-frontalis muscle and the pericranium, or between the latter and the bone. Besides the local appearances here described, fracture with depression may be attended with the usual symptoms of compression of the brain ; for an account of which I must refer the reader to the chapter on Compression.

In regard to these symptoms, the intelligent surgeon will not only keep in mind the different conditions on which they depend, but in order to arrive at a correct diagnosis, and to ascertain from which of the various different conditions the symptoms in any particular case may proceed, he will inquire very minutely into the history of their appearance. Compression of the brain, proceeding from external injury, may be occasioned by a depressed portion of bone, or extravasation of blood, or the formation of purulent matter. The time when the symptoms made their appearance, will be found the surest guide in determining to which of these three causes they are to be attributed. When a depressed portion of bone occasions the compression, the symptoms present themselves from the very occurrence of the injury ; when extravasation of blood is the cause, the symptoms do not appear immediately, except sometimes in a very slight degree, and it is not until a considerable quantity of blood has collected, that they show themselves very decidedly. When a patient, having been stunned by an injury of the head, recovers from the stun, and symptoms of compression afterwards appear and gradually increase, there is then reasonable ground for supposing that they arise from effusion of blood. When the compression is caused by the formation of matter, it does not appear for several days, and is preceded by the symptoms of inflammation of the brain, or its membranes. Thus the history of the symptoms is a useful guide in determining the cause on which the compression depends. It is important

Fig. 48.



Fig. 48. Fracture of cranium with depression. From a preparation in my museum.

to remember that the injury of the one table scarcely ever corresponds with that of the other, the inner being almost always fractured to a greater extent than the outer, and the actual depression of the inner table being much greater than would appear from the examination of the outer part of the cranium. It is a remarkable fact, but one of which the records of surgery furnish many examples, that there is no certain correspondence between the symptoms of compression, and the extent to which a portion of the bone may be depressed. In some instances where the depression has not been to a great extent, the symptoms have been decidedly marked; in others, the symptoms have been very slight, when the depression has been manifest and considerable. Hence the statement of an eminent modern writer, "It is extraordinary and unaccountable, but it is not less true, that no calculation of the bad effects can be made, by the degree to which a part of the skull is depressed." Several very interesting cases confirmatory of this fact will be found in Thomson's Observations made in the military hospitals in Belgium.

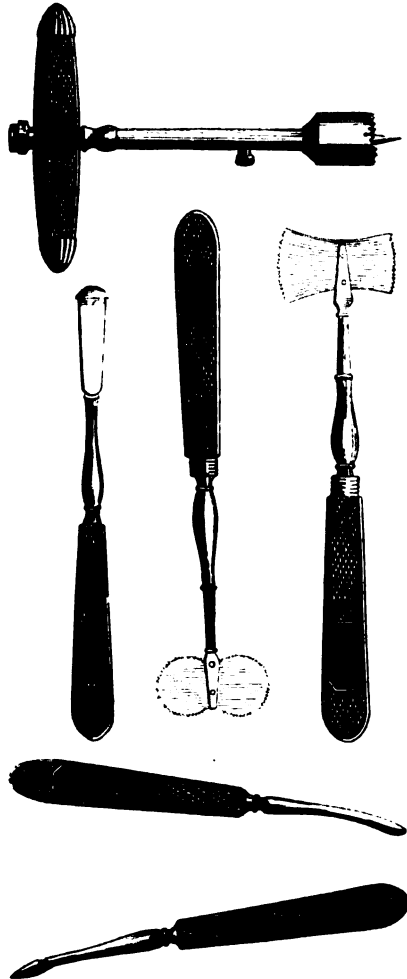
Treatment.—The object to be aimed at by treatment varies according to the presence or absence of the symptoms of compression. In the absence of these symptoms, the indication of treatment is to prevent the occurrence of inflammation, and for that purpose the strict antiphlogistic regimen, consisting of low diet, rest, and quietude, should be enjoined. It is also advisable to shave the head, to keep it cool by means of cold applications, to administer some smart purgative, and in some habits of body, it is prudent, even as a precautionary measure, to have recourse to depletion, provided there be much reason to apprehend inflammatory action. It would, however, be extremely injudicious to have recourse to depressing treatment in the period of collapse which immediately succeeds such an injury; and after this period is passed by, the extent to which this treatment ought to be carried should be regulated by the age, habits, and constitution of the patient, and the particular circumstances of the case.

If symptoms of depression be present, then the immediate object to be aimed at, is to relieve the brain from pressure; and the means to be taken, in the first instance, for that purpose, will depend on the extent of the depression, and the urgency of the symptoms. If the bone be not depressed to a very great extent, and if the symptoms be not extremely urgent, the attempt should first be made to relieve the pressure of the brain by bleeding, purging, and the constant application of cold to the head after it has been shaved. Under this alleviating treatment, the brain sometimes becomes accommodated to its new condition, and the symptoms disappear. If after the proper measures have been employed for a moderate period, the symptoms still continue, then the depressed portion of bone must be elevated. But if the depression be not only manifest, but also to a great extent, and the symptoms of compression be very strongly marked, then the surgeon is justified in elevating the depressed portion of bone without waiting to ascertain the effect of the alleviating treatment recommended above. It appears, then, that in this variety of fracture, the circumstances under which the surgeon is warranted in proceeding to operate, are,—either when the symptoms continue unabated after the judicious employment of bleeding, purging,

and the constant application of cold to the head; or, without waiting for the employment of these remedies, when the symptoms are alarmingly urgent, and the bone depressed to such an extent as to leave no hope of the brain becoming accommodated to its unnatural condition. When, in either of these cases, the surgeon has resolved to elevate the depressed portion of bone, he should first expose the fracture by making a crucial incision, and then raise up the bone by means of some of the different forms of elevators used for that purpose. If, as is often the case, it should be impossible to introduce the elevator underneath the depressed portion, the surgeon is justified in trephining, his object being, not to saw out the depressed portion, but to remove a part of the bone which is not depressed, so as to admit of the introduction of the elevator, by which the depressed part may be raised to a level with the surrounding parts of the cranium.

I cannot conclude this chapter without referring to a most extraordinary case, which shows, that at a very distant period from the accident, the symptoms of compression may be removed and the patient restored to his ordinary powers of body and mind. The case seems to have produced a deep impression on the mind of Sir Astley Cooper, who records it in the following words:—"The other circumstance which I shall mention, is one, which, whether we regard it in a physiological or surgical point of view, is perhaps one of the most extraordinary that ever occurred; and, as connected with surgery and physiology, I am surprised it has not made a greater impression on the public mind than it appears to have done. A man was pressed on board one of his majesty's ships, early in the late revolutionary war. While on board this vessel in the Mediterranean, he received a fall from the yard-arm, and when he was picked up he was found to be insensible. The vessel soon after making Gibraltar, he was deposited in an hospital in that place, where he remained for some months still insensible, and some time after he was brought from

Figs. 49-54.



Gibraltar on board the 'Dolphin' frigate to a *dépôt* for sailors at Deptford. While he was at Deptford, the surgeon under whose care he was, was visited by Mr. Davy, who was then an apprentice at this hospital. The surgeon said to Mr. Davy, 'I have a case which I think you would like to see. It is a man who has been insensible for many months; he lies on his back with very few signs of life; he breathes, indeed, has a pulse, and some motion in his fingers; but in all other respects he is apparently deprived of all powers of mind, volition, or sensation.' Mr. Davy went to see the case, and on examining the patient found that there was a slight depression on one part of the head. Being informed of the accident which caused this depression, he recommended the man to be sent to St. Thomas's Hospital. He was placed under Mr. Cline, and when he was first admitted into this hospital, I saw him lying on his back, breathing without any great difficulty, his pulse regular, his arms extended, and his fingers moving to and fro to the motion of his heart, so that you could count his pulse by this motion of his fingers. If he wanted food he had the power of moving his lips and tongue; and this action of his mouth was the signal to his attendant for supplying his wants. Mr. Cline, on examining his head, found an obvious depression; and thirteen months and a few days after the accident he was carried into the operating theatre and there trephined. The depressed portion of bone was elevated from the skull. While he was lying on the table, the motion of his fingers went on during the operation; but no sooner was the portion of bone raised than it ceased. The operation was performed at one o'clock in the afternoon. And at four o'clock as I was walking through the wards, I went up to the man's bedside, and was surprised to see him sitting up in his bed. He had raised himself on his pillow; I asked him if he felt any pain, and he immediately put his hand to his head. This showed that volition and sensation were returning. In four days from that time the man was able to get out of bed, and began to converse; and in a few days more he was able to tell us where he came from. He recollected the circumstance of his having been pressed, and carried down to Plymouth or Falmouth; but from that moment up to the time when the operation was performed (that is, for a period of thirteen months and some days) his mind remained in a state of perfect oblivion; he had drunk, as it were, the cup of Lethe; he had suffered a complete death, as far as regarded his mental, and almost all his bodily powers, but by removing a small portion of the bone with the saw, he was at once restored to all the functions of his mind, and almost all the powers of his body. It appears, therefore, that in cases of depression we should not be prevented from trephining, however distant the period may be at which the accident occurred, and the patient may, after any interval, be restored to the powers of body and mind."

III. PUNCTURED FRACTURE.

When a fracture is caused by a sharp body, such as a corner of a stone, or by any pointed instrument, such as a bayonet or a pitchfork, or by a sharp-pointed body of any kind, which applies force with concentrated effect, it usually presents the appearance of a cavity, or mere

puncture, and is hence called a punctured fracture; and because there are often numerous fissures radiating on every side from the centre, it is also called star-like or radiated fracture. From the manner in which such a fracture is occasioned it is often attended with a wound of the soft parts. The internal table is, on account of its brittleness, injured to a greater extent than the external, and there is one circumstance in this form of fracture which renders it so exceedingly dangerous as to require immediate recourse to an operation, even in the absence of compression, or of every bad symptom. This circumstance is, that spicular portions of the internal table are always driven inwards, and if these be not removed, it is almost certain that inflammation will be excited, and if so, the ordinary remedies will have no effect, while the exciting cause continues; and if the operation be delayed until inflammation has taken place, it will then be too late to save the patient. In short, the very existence of this form of fracture imperatively calls for an operation. On exposing the fracture the depressed portions should be raised; and if it be impossible to introduce the elevator or forceps, it will be necessary to remove a small part of the sound portion of the cranium for the admission of the instrument. After the cause of irritation has been removed, and the edges of the wound been approximated, the treatment will consist of the rigid institution of antiphlogistic regimen to prevent inflammation, and to subdue it in case of its occurrence.

Fig. 55.



IV. COMPOUND OR OPEN FRACTURE WITH DEPRESSION.

On this important subject, Sir Astley Cooper remarks, "Compound fracture is followed very generally by inflammation of the brain, and it will be of no use to trephine, when inflammation is once formed. It might be thought that it would be time enough to perform this operation when inflammation had appeared; but this is not the case; for if inflammation comes on, the patient will die, whether you trephine or not; and you will be so far from arresting its final progress by trephining that the operation will add to the danger of the inflammation. When inflammation of the dura mater and membranes has been excited by depression of the bone, you cannot retard the progress of death by performing the operation."

Sir Astley Cooper enforces these principles by cases, and concludes by saying, "The elevation of the bone is never followed by any mischief; but if you do not raise it, and inflammation follows, it will be

too late to attempt to save the life of the patient." In reference to this doctrine laid down by Sir Astley Cooper, Sir Benjamin Brodie, after referring to the fact that many persons undoubtedly have recovered, in whom there was at the same time a wound in the scalp and a fracture with depression of the cranium, although no operation was performed, and after referring to examples published by Mr. Abernethy, and various cases which occurred at the battle of Talavera de la Reyna, and were communicated by Mr. Rose, Surgeon to the Coldstream Regiment of Guards, goes on to say, "I have conversed also with other surgeons, whose experience has compelled me to doubt the accuracy of Sir Astley Cooper's conclusion. The question, however, is not to be decided merely on these premises. Many persons may do well without an operation, who suffer from what Sir Astley Cooper denominates a compound fracture of the cranium, and yet it may remain to be determined what is the probability of suppuration taking place in these cases as compared with those in which the scalp remains uninjured. For many years I have preserved notes of a large proportion of the cases of injury of the head, which it has fallen to my lot to witness. Among them, of course, are many in which there was fracture with or without depression, followed by suppuration between the dura mater and the bone. On referring to these for further evidence on this interesting subject, I find that the cases in which suppuration takes place where the scalp is entire, have been comparatively rare; bearing a very small proportion indeed to those cases in which suppuration has followed a fracture complicated with a wound of the scalp. Such is the result of my own experience during a considerable period of time, and which I am enabled to give, not merely from a general recollection of what I have seen, but on the authority of written notes, made at the bedside of the patients, and, for the most part, before the question which they illustrate had ever presented itself to my mind. Taking all these facts into consideration, and endeavouring to give its proper value to what may be urged on either side of the question, I cannot but acknowledge, whatever may have been my first impression on the subject, that it appears to me at this moment that the views of Sir Astley Cooper are well founded, and that in those cases in which a depression of bone exists, without any symptoms, or with only very trifling symptoms, arising from it, the surgeon can follow no better general rule than this; if the depression be exposed in consequence of a wound of the scalp, let him apply the trephine, and elevate the depression; but if there is a depression without a wound of the scalp in consequence of the accident, let him not make such a wound by an operation."

From the above, it will be evident that the views of Sir Astley Cooper, as to the necessity of trephining in compound fracture with depression, in the absence of any symptoms of pressure, received, after much deliberation, the decided approval of Sir Benjamin Brodie. A different opinion, however, is maintained by many surgeons; and Professor Samuel Cooper, as will appear from the following extract from his lectures, seems inclined to agree with those who do not recommend an operation, except when symptoms of compression are present. In speaking of the doctrine laid down by Sir Astley Cooper, he says, "I

cannot say that the observations which I have had opportunities of making on this point of surgery, would have led me to adopt this opinion." Sir Philip Crampton remarks on this subject, "In Dublin we conform in general to the rule of practice originally laid down by Dease, who preceded Desault by many years, namely, in fractures of the skull with depressed bone, *whether complicated by wound of the scalp or otherwise*, no attempt should be made to raise the depressed bone, *unless very decided symptoms be present of compressed or irritated brain.*"

Sir P. Crampton mentions that he has seen many cases terminate very favourably without the trephine, and refers to some in the very interesting paper in which he states the above views. On this point it will be evident that Sir P. Crampton and Professor Samuel Cooper are agreed, and that their opinion is opposed to that of Sir Astley Cooper and Sir Benjamin Brodie. Some surgeons are of opinion that in the absence of compression, trephining is justifiable only when the compound fracture partakes of the nature of punctured fracture; and others, that the surgeon should be guided by the extent of the depression, the condition of the fragments, and the possibility of elevating them without increasing the wound of the scalp. For my own part, as Sir Astley Cooper's opinion is given with so much decision, and is founded on so extensive an experience, I should very much hesitate to advise any different procedure.

V. FRACTURE WITH DEPRESSION OF THE EXTERNAL TABLE.

Fracture of the external table, with depression into the diploë, cannot take place either in early life or frequently in old age, as the skull is, at both these periods, comparatively thin and without diploë; but that it has taken place in the middle period of life, is no longer a matter of uncertainty. This condition of the external table, the internal remaining at the same time perfectly entire, has now been demonstrated by many specimens, in which the occurrence of reunion proves that the patients must have lived for some time after the injury. The possibility of this condition suggests the propriety of caution in forming a diagnosis, and furnishes a reason why mere depression of a part of the cranium does not, if unaccompanied with compression, warrant the performance of trephining.

If unattended with concussion, this injury is not likely to lead to any serious consequences, nor does it require any treatment beyond the precautions proper to be attended to, after every kind of injury about the head.

VI. FRACTURE WITH DEPRESSION OF THE INTERNAL TABLE.

The records of surgery furnish various examples of this fracture, every instance of which, attended with unfavourable symptoms, must form a case of great anxiety and difficulty to the surgeon. Professor Samuel Cooper records a case of this kind, with urgent symptoms, in which he performed the operation of trephining at Brussels, after the battle of Waterloo. The external table was perfectly entire, but a large splinter of the inner was driven more than an inch into the brain, and on its removal the patient's senses and power of voluntary motion

returned. The part of the skull to which the trephine was applied, did not, of course, present any depression, and it was selected because the appearance of the scalp showed that there the external violence had been inflicted. In Dr. Hennen's Military Surgery, a case is recorded in which the external table was entire, and the internal splintered and driven more than half an inch into the brain.

If a patient has been struck, or has fallen upon a certain part of his head, and if the external table be entire, and the symptoms of compression supervene, the difficulty of diagnosis is sometimes very great, for the history of the symptoms is almost the only guide to the surgeon in forming a conjecture as to whether the symptoms be caused by depression of the internal table, by extravasation of blood, or by matter; and yet it is sometimes impossible, from the history, to arrive at a decided opinion, because although it is true that in depression the symptoms which indicate the state of the brain come on immediately after the injury, and in extravasation, some time elapses before they appear, and they become more distinctly marked as the blood is effused from the ruptured vessels; still, in a case of extravasation, the patient may have been insensible in the first instance from being stunned, or from the concussion of the brain, and before the insensibility from this cause has worn off, insensibility from compression may have come on; in such a case, the patient having been insensible from the very occurrence of the injury, it would be impossible to determine whether the compression has been caused by extravasation, or by fracture with depression; and accordingly we find that in some successful cases, in which trephining was performed, in the expectation of finding the cause of pressure to be blood extravasated under the cranium, it turned out to be fracture with depression of the inner table. But supposing the injury of the internal table has given rise to extravasation of blood, or the formation of matter, although the surgeon should think that there is little doubt which of these is the cause of the symptoms in any particular case, still he has no certain guide as to the precise seat of the collected matter; he has no decided and unequivocal symptom to enable him to determine whether the blood be above or below the membranes of the brain, and consequently the real nature of the case, and the exact condition of the patient, must be very uncertain, and the indications of treatment extremely doubtful and precarious. It would be saying too much to affirm that in every instance the surgeon should confine himself to the use of the alleviating remedies for pressure, formerly enumerated, and that what has very appropriately been called "exploratory trephining" should never be performed in any case. The case in which the indication of treatment would be most clear, and the operation, if ever advisable, most warranted, is where symptoms of compression come on after an injury in the situation of the middle meningeal artery. On this subject Sir Benjamin Brodie remarks:—"Where no fracture is discovered, yet if there is other evidence of the injury having fallen on that part of the cranium in which the middle meningeal artery is situated, the use of the trephine may be resorted to on speculation, rather than that the patient should be left to die without an attempt being made for his preservation. I cannot indeed adduce any particular

experience of my own in favour of what is here recommended ; but I conceive that the instances which have been recorded, in which the middle meningeal artery has been ruptured without any fracture of the bone, and the known fact that there is sometimes a fracture of the inner table, sufficiently justify such an experiment in desperate cases, or even in those in which there is much danger."

On the very important and interesting subject of fractures of the cranium, I must limit myself to the above observations ; but at the conclusion of the chapter on Compression of the brain, will be found an enumeration of the conditions, in which, according to the views now entertained regarding the treatment of injuries of the head, the operation of trephining is considered advisable.

CONCUSSION OF THE BRAIN.

Causes.—The injury which is termed by British authors "Concussion of the Brain," by French, "Commotion," and in common parlance "stunning," is produced by one or other of the three following causes :—a blow, or a fall, on the cranium itself, or a fall from a considerable height on some other part of the body, as the buttocks, or the feet, by which a sudden shock is communicated to the brain, through the medium of the vertebral column. I lately had under my care a mason, in whose case there were strongly-marked symptoms of concussion, caused by his falling from the second floor of a house on his buttocks ; and I am at present attending a female, who, in consequence of the horse becoming restive, jumped from the top of a cart loaded with hay, and alighting on her feet sustained fracture of one leg, and concussion of the brain. The spine in these circumstances is suddenly brought into a state of rest, and the head being still in projectile motion, is forcibly struck against the summit of the vertebral column : the sudden jerk thus communicated to the brain occasions "concussion."

Symptoms.—For facilitating the description of the symptoms of concussion, it will be convenient to adopt Mr. Abernethy's arrangement of them into three stages ; an arrangement not only advantageous for promoting a clear understanding of the symptoms, and for reconciling by accurate discrimination some of the various descriptions of them given by previous writers, but valuable also, together with his other observations, as having led to more correct and scientific views of practice than formerly prevailed. By referring to his *Surgical Observations on injuries of the head*, it will be found that he arranged the symptoms into three stages, which he called the first, second, and third. The first stage, which immediately follows the injury, is one of collapse, in which there is insensibility, with derangement of bodily powers ; the second is one of reaction, in which there is, to a greater or less extent, some return of sensibility, and restoration of bodily powers ; and the third is one of inflammation of the brain, indicated at first by increased excitement of that organ, and increased vascular action ; and this stage is certainly not the least important of the series of consequences which result from concussion.

In well-marked examples the different stages are characterized by the following symptoms.

In the first stage, the operations of mind are in many instances suspended, and often to such an extent, that consciousness is entirely lost for the time; the functions of the brain and of the organs of sense are also suspended, so that there is complete insensibility to all external impressions. Common sensation and voluntary motion are also lost for the time; and often the loss of sensation is so great, that the patient gives no indication of being pained, on pinching or irritating the skin; in short, he does not feel any injury inflicted on him; and with regard to motion, it does not so much seem to be the power of contractility that is lost, as the power of voluntarily combining the action of the muscles, so as to perform any particular movement. The operations of mind, and the powers of sensation and of voluntary motion, are usually suspended together, but I have seen instances in which the loss of the one is greater than that of the other; and Sir Astley Cooper records a well-marked example in a gentleman, who at one time, in the absence of his attendant, got out of bed, bolted the door, passed water, and went to bed again, and yet he was so insensible, that every attempt to get a word from him was ineffectual, and Sir Astley Cooper says, he does not believe the noise of an earthquake would have succeeded in rousing him from his lethargy. The countenance is pale and collapsed; the surface, especially at the extremities, cold; the respiration is by some observers said to be easily and naturally performed; in slight cases, certainly, it is almost natural, but in such as are well marked, it is very feeble and without sterter. The pulse is weak, slow, fluttering, and often intermittent, and in the extremities scarcely perceptible. The pupils contract on the application of light, showing that the retina is not perfectly insensible, and as regards the size of the pupil, in the cases of which I have kept notes, it was usually contracted when the concussion was slight, and dilated when it was very severe. Some authors have occasionally found one pupil contracted and the other dilated, and in the first instance, not dilating in darkness, nor contracting farther when the light was suddenly increased. Vomiting is an early symptom, and is referred to that well-known sympathy between the brain and stomach, of which so many examples could be given; a sympathy maintained through the pneumogastric nerves. If the concussion be severe, and the symptoms continue long, there may be the same condition of the urinary organs as in compression, the rationale of which condition will be explained in the chapter on Compression.

The above symptoms may be changed into those of the second stage, or into those of compression, or they may terminate fatally without passing through any further change.

In the second stage, the operations of mind are not so completely suspended as in the first, and the insensibility is diminished, although still so great, that ordinary impressions produce little effect, and the powers of attention and perception are still in a great measure lost; the functions of sensation and volition are also in a considerable degree restored. In consequence of this alleviation, although the patient lies as in a kind of sleep, it is possible to rouse him for an instant. By putting a question to him in a loud, sharp tone of voice, an answer is obtained in a monosyllable, and in such a manner, as if his attention were taken up

about something else, and he instantly relapses into his former state. Such questions seem to be more readily answered, if they refer to the patient's state. The pupil is usually contracted, and the sensibility of the retina is evinced by the patient drawing his head from the light, when the eyelids are opened. The functions of the organs of sense, though much less acute than naturally, are not entirely suspended; and sensation and power of motion are in a great measure restored, as will be shown by his drawing away his limbs when they are pinched. Although the patient lies in a comparatively insensible state, and generally in the position in which his body happens to be placed, yet there are occasional fits of restlessness, and in this respect concussion differs from compression, inasmuch as in the latter state, there is uniform and permanent insensibility with total loss of the power of motion. The circulation and respiration are more vigorous in the second stage than in the first; and in consequence, a natural warmth is diffused over the body. The pulse is firmer, fuller, and stronger; and if the patient be so far recovered as to be able to raise himself up, or to make any exertion, a condition of pulse will be perceptible, which is quite characteristic of concussion;—I refer to its very great acceleration when the patient rises up, or makes exertion of any kind. Sometimes when the pulse is not more than from seventy to eighty in the recumbent posture, it is so greatly accelerated by the patient's rising, as to reach from one hundred and twenty to one hundred and thirty in a minute. There is also in general, an unusually strong beating of the carotid vessels, especially on making exertion; and when the patient is able to describe his feelings, he generally complains of headache. I lately had under my care a lady with concussion of the brain, in whose case great throbbing of the carotid vessels, and great acceleration of the pulse continued for a very considerable time after all other traces of the injury had disappeared.

The above symptoms may gradually subside, or they may pass into those of compression, or into those of the third stage.

The third stage is one of pure inflammation of the brain, and is indicated by great pain in the head, increased heat and throbbing of the vessels about the head, full and flushed countenance, intolerance of light and sound, of light, sometimes even through the eyelids, suffusion of the eyes, watchfulness, restlessness, and delirium, together with great quickness of pulse, heat, and dryness of skin, diminution of secretion, and in short, all the usual symptoms of irritative fever.

These symptoms may yield to remedies, or they may pass into the symptoms of compression, and prove fatal in the way of coma.

Such are the symptoms of concussion in well-marked examples, when the disease runs its course; but, as in other injuries, the symptoms vary according to the violence of the concussion, so that between slight, transient stunning, which wears off in a few minutes, and the state described above, there are many intervening shades. Sometimes, the patient appears merely to have received a slight stun, and in a few minutes he is quite well; in other instances, the symptoms are more marked and of longer duration, yet they wear off without being succeeded by any signs of the inflammatory stage; and in other instances, the disease runs its course, and the patient falls a victim to it, death taking place in the

way of coma. Sometimes concussion and compression exist together, and the phenomena of these two states, are so intermingled, that the surgeon is occasionally at a loss to determine on which condition chiefly the symptoms depend.

CONSEQUENCES OF CONCUSSION SOMETIMES OBSERVED.

Some patients recover from even very severe forms of concussion, without having in after life any trace whatever of the injury ; but others are found to suffer various affections resulting from it, for a considerable time after their recovery, or even through their whole life. These consequences may affect either the mind or the body. The power of continuous attention is often lost, or very much diminished ; slight weakness of intellect, and even complete mental imbecility have sometimes been occasioned ; but of all the mental powers, the memory is most frequently affected, the injury being attended with this peculiarity, that all recent events and impressions are forgotten, while those of an earlier period are remembered. For example, it has been found that a patient, who before concussion, conversed in a language recently acquired, had on his recovery entirely forgotten it, but that he was still able to speak a language which he had acquired long before. In some cases, the recollection has been lost of almost all impressions of a late date, while those of early life are distinctly remembered. This affection of the memory has been compared to that which takes place in old age, and it has been said, that in this respect, patients appear, as far as memory is concerned, as if they had suddenly grown old. In some instances, the affection of the memory has a different character, and the patient is unable to remember the proper word to be used for naming an object, or for describing its quality. Desault mentions a curious case of a man, who after concussion, could remember only recent events, but afterwards lost the recollection of everything recent, and could only remember what had occurred in his early life. It is sometimes found that some of the organs of the external senses are permanently affected ; thus, the use of one ear, or of one eye, may be altogether lost, or the sight considerably impaired. In some instances, the sight is affected in a peculiar way, so that only part of an object can be seen at one time, and the patient must move his head in order to obtain a view of the whole object. To such an extent has this been observed in some cases, that the patient has been unable to see all the letters of a word at the same time. Severe vertigo, or pain of head, on making any exertion, and great muscular weakness, are very frequently consequences of concussion.

DIFFERENT WAYS IN WHICH CONCUSSION PROVES FATAL.

It would be quite foreign to the object of this work to give any detailed account of the experiments made by physiologists to ascertain the effect produced on the organs of circulation by injuries on the brain and spinal cord ; but the following results of experiments on the nervous centres, and the conclusion drawn from them, as bearing on the interesting subject under consideration, may be here given. 1st. Legallois, and Dr. Wilson Philip, in their experiments, carefully removed the

whole of the brain and spinal cord, and *when artificial respiration was kept up*, the action of the heart did not cease for some hours; from which experiments, the conclusion is drawn, that the action of the heart is independent of the brain or spinal cord. 2d. In the experiments of the same physiologists, it was found that when any sudden and extensive injury, as a violent concussion, was produced on part of the brain or spinal cord, an immediate and great depression, or complete suspension of the action of the heart, was the result; from which it is concluded that a sudden injury of the nervous centres, such as a violent and sudden concussion, suspends the action of the heart, and thus proves fatal; that, in short, death occurs by syncope, or begins at the heart. The vital power of the heart seems to be destroyed; for, when the chest is opened immediately after death, it is impossible to excite any contraction, and in that respect, as will afterwards be shown, the condition of the organ is not the same as in death by coma, where the immediate cause of death, as will be seen in the chapter on Compression, is asphyxia, or suspended action of the lungs.

3d. From the experiments of Chossart and others, there appears to be some variety as to the part of the circulation chiefly affected by certain injuries of the nervous centres. Chossart found in some of his experiments, that in certain injuries of the brain and spinal cord, the circulation in the capillaries appeared to be for some time more affected than the action of the heart; but still it is by failure of the circulation that such injuries ultimately prove fatal. It is only by a knowledge of the dangers which threaten in different stages that we can be guided to rational and scientific principles of treatment.

When concussion proves fatal in the first stage, it is by failure of the action of the heart; sometimes this failure is instantaneous; sometimes it goes on gradually increasing to a fatal termination; and sometimes there is a very partial reaction, and then a second failure of the organs of circulation, which proves fatal. It is evident, therefore, that the state of the circulation must, in this stage, be watched with much anxiety by the skilful practitioner.

When concussion has proved fatal by failure of the heart's action, the heart is in some cases, particularly in those which have been very suddenly fatal, found to be quite empty, a circumstance the cause of which, as Dr. Alison remarks, is not easily explained. In other cases it is distended; but the distinguishing peculiarity is, that there is no difference in the quantity of blood in its right and left sides: in this respect, also, the state of the heart is different in death by asphyxia, as will be shown in the chapter on Compression.

Another way in which concussion proves fatal, is by compression of the brain. This may take place soon after the injury, when blood from the vessels of the lacerated portion of brain has had time to accumulate in some quantity; or after reaction has taken place from extravasated blood; or in the third stage from serous effusion, or the formation of purulent matter, as results of inflammation.

APPEARANCES AFTER DEATH.

The appearances within the head vary according to the length of time between the injury and the fatal event. Separation of the dura

mater from the inner surface of the cranium, when the blow on the head was severe, is a very common condition. In cases which almost instantly, or very quickly prove fatal, laceration of a portion of the brain is often observed; but it has long been ascertained by the investigation of surgeons that concussion often proves fatal, and that very suddenly, without any perceptible unnatural condition either of the cerebral substance, or of the vessels within the head; in short, without any discernible injury of the brain, its vessels, or its membranes. In cases rather more advanced, small specks of blood in some parts, or laceration of the brain are met with; and in cases still further advanced, besides some of the above appearances, various traces of inflammation are observed, such as a turgid condition of the vessels, increased vascularity in the membranes or brain, or various kinds of inflammatory effusion, as serous, gelatinous, or purulent, or sometimes of lymph, or different combinations of some of the above results of inflammation. Surgeons have been anxious to determine in what way concussion suspends to a fatal extent the function of the brain in those instances, in which no derangement of its organization is discernible on dissection. Some suppose it may be by the sudden shock disturbing the circulation of the brain, but others think it more probable that the structure may be injured, although the injury may not be discovered by dissection. Sir Benjamin Brodie seems to be of the latter opinion; he remarks, "If the brain is on so minute a scale that our senses are incapable of detecting it, it is evident that there may be changes and alterations of structure, which our senses are incapable of detecting." Some surgeons, again, seem to think that the fatal suspension of function may be caused by condensation of the brain. Mr. Liston says, "When a blow is inflicted on the skull, only a slight commotion of the brain is induced, the cranial contents are, as it were, slightly jumbled, and a temporary and trifling effusion of its functions follows. When, however, the stroke is more severe, the brain is separated from its cranial attachments, both at the point struck, and at the part directly opposite; it is thrown upon itself towards its centre; its substance is thereby condensed, its diameter in the direction of the impulse diminished, and a separation between the brain and cranium is formed at each extremity of that diameter. By post-mortem examinations, it has been ascertained that condensation of the substance of the brain does exist in cases of severe concussion. Such condensation may be sufficient to cause instant extinction of life, or the brain may gradually resume its former condition, or with only such slight incited action as may be required to reunite the dura mater with the inner table of the skull." Such are the opinions which have obtained on this subject, but it appears very evident that our knowledge of it is still very imperfect.

Treatment.—There are few points on which greater diversity of opinion has prevailed than on the treatment of concussion; indeed, two directly opposite methods have each had their advocates. Some surgeons, from a supposed analogy between insensibility in fainting and insensibility in concussion, have advised stimulants and cordials; while others inculcate the necessity of bleeding and other antiphlogistic remedies. Pott in England, and Boyer in France, insisted on the necessity

of bleeding; the latter to an extent unknown in this country. From the arrangement of the phenomena of concussion into three stages, from the condition on which the symptoms depend, and from what has been ascertained regarding the different ways in which it proves fatal, and the dangers of each stage, rational and scientific principles of treatment have been deduced. The treatment proper for each stage is a subject of great practical importance.

In the First Stage, when the symptoms of depression of the powers of life are so urgent that there is danger of death from failure of the circulation, it would certainly be extremely injudicious still further to depress the system by bleeding; for this would be almost to take away the patient's chance of life: but, on the other hand, it would be hazardous to administer wine, stimulants, or cordials, as the occurrence of phrenitis, the condition on which the third stage depends, would be rendered more certain, and its severity, if it should occur, be in all probability increased. Such means should therefore be employed to restore the circulation as are not calculated to have a permanently stimulating effect. With this view the patient should be laid in bed, covered with warm blankets, and having heat applied to the surface of the body, more especially to the extremities and abdomen. When the circulation is restored, the heat should be withdrawn. When the power of swallowing is regained, if the above means should not have produced the desired effect, and the patient be evidently in a very dangerous state, the surgeon may venture upon the use of some of the diffusible stimulants, such as ammonia. Since ammonia and other diffusible stimulants have not any permanent effect on the circulation, there is not the same objection to their use as to that of brandy, wine, or any such powerful stimulants. The state of depression is generally but temporary, and the reaction usually proportioned to the depression; hence the danger of giving any powerful stimulant. If there should happen to be laceration of the brain, which, as has been already stated, is a condition often existing in concussion, then the period of depression of circulation tends to diminish the danger of internal hemorrhage; and this furnishes an additional argument in favour of the practice of avoiding stimulants: whereas, if the circulation be artificially excited, there is greater danger of compression from internal hemorrhage, and of phrenitis; and it has been already mentioned that these are two of the ways in which concussion proves fatal.

In the Second Stage, the object to be aimed at is, to moderate the reaction, and thus to prevent, if possible, the occurrence of the symptoms of the third stage. The patient should be placed in a cool, quiet, dark room, and every external source of excitement avoided; the shoulders should be a little raised; the head shaved, and cold applications applied to it; the bowels should be freely purged, and the diet of the most unstimulating kind. If there be any evidence of increased vascular action, it may be advisable to bleed from the arm; but on this point the surgeon must be guided entirely by the state of the pulse, and not by the insensibility, which cannot be removed by bleeding. After the proper restoration of the circulation, if there be evidence of increased vascular action, a moderate bleeding may prevent phrenitis; and, if there be laceration, it may tend to arrest extravasation of blood on the

brain. When recourse is had to bleeding in this stage, it is chiefly as a precaution.

In the Third Stage, the treatment is the same as in ordinary cases of phrenitis, namely, depletion both general and local; the efficient application of cold to the head by means of cloths out of evaporating lotions, or of water rendered very cold by ice, or of ice itself and water in a bladder; smart purging of the bowels, with low diet, and attention to all necessary precautions for avoiding light, noise, and everything which could prove a cause of excitement or irritation. Care, however, must be taken that bleeding be not carried too far. The following reasons suggest the necessity for caution.

1. If there be laceration of the brain, the amount of inflammation necessary for obtaining reunion may be prevented. Sir Astley Cooper records a case which occurred in the practice of another surgeon, where depletion was carried too far, and on dissection there was found laceration, without any attempt at reunion.

2. Phrenitis is an inflammatory disease, in which it is well known that patients do not bear depletion to the same extent as in some other inflammatory attacks.

3. Repeated copious bloodletting produces of itself confusion of mind, pain of head, a hardness and jerking condition of pulse, giddiness, and other symptoms, which an inexperienced observer may mistake for the symptoms of the injury.

When the powers of life in this stage seem to be failing, recourse may be had to stimulants; and it is surprising how patients sometimes rally under them in instances where the symptoms are very unpromising, and death seems very near.

Throughout all the stages the state of the bladder must be carefully attended to, and the catheter used, if necessary.

COMPRESSION OF THE BRAIN, OR COMA.

Symptoms.—In sanguineous apoplexy we have a good illustration of the symptoms of compression of the brain. In well-marked cases there is complete suspension of consciousness and of all mental operations. From the brain being incapable of receiving impressions from the nerves, there is suspension of the functions of the external senses, and of common sensation; and from its being unable to transmit the influence of the will through the nerves to the muscles, there is loss of voluntary motion. The muscles are relaxed, and the body remains in any position in which it may be placed. Both in compression and in concussion, sensation and voluntary motion are suspended; the characteristic difference is, that in the former the suspension is constant and uniform while the compression continues; in the latter there are, even, during the continuance of the concussion, occasional fits of restlessness, and the symptoms have a tendency to wear off.

The retina is perfectly insensible; if the eyelids be opened and a candle be placed near, no perception of light is evidenced; the iris is motionless, and the pupil dilated. This is the condition of iris generally found, and, therefore, regarded as a symptom of compression,

though sometimes the pupils have been found at first contracted and fixed, and afterwards dilated and fixed.

The respiration is slow, difficult, and stertorous. The relaxation of the *velum pendulum palati*, and of the muscles of the larynx and pharynx, prevents the free passage of the air, and gives rise to the noise in breathing called stertor. In very bad cases the air puffs out the cheeks and lips, and elevates the latter in passing out: this is always viewed as an unfavourable symptom. In consequence of the insensibility, the uneasy sensation in the chest caused by the presence of venous blood in the lungs, which under ordinary circumstances excites respiration, is not felt; and in addition to this, the muscles of respiration are paralysed. It is this condition of the respiratory apparatus which is the immediate cause of death; in other words, death is caused by asphyxia; and, therefore, the condition of respiration is watched by the surgeon with the utmost anxiety.

The pulse is for the most part slow, full, and labouring. It has already been stated that, although the action of the heart is independent of the brain, inasmuch as the whole of the brain of an animal can be removed, and if the respiration be kept up, the action of the heart will continue for some hours, yet it is disturbed by a sudden injury of the nervous system;—in concussion for example, the heart's action is diminished to a very great degree in the manner already described; in compression, however, the pulse is affected in a different way. In concussion, it is weak, small, and fluttering, whereas in compression it is slow, full, and labouring. The action of the heart is diminished, weakened, and sometimes entirely suspended by concussion, as by a sudden injury of the nervous system; whereas in compression it does not seem to be at all affected directly, but to become impeded and interrupted from the obstruction of circulation through the lungs, caused by the tendency to asphyxia. In the one case the effect is produced directly on the action of the heart, in the other directly on the action of the lungs, thereby rendering it more than ordinarily difficult for the heart to perform its function. Experiments of sawing out a portion of the cranium, and applying pressure to the brain, have been performed on the lower animals, to ascertain the effect on the pulse; and the result observed has been, that the pulse becomes slower and labouring when severe pressure is applied, and rises when the pressure is removed. The same effect is observed in injuries of the human body; when the brain is severely compressed by a depressed portion of bone, the pulse becomes slow, and it is observed to rise, and often very suddenly, when the pressure is removed. This effect, as has been already stated, is believed to be occasioned by the condition of the lungs. Some cases are recorded in which the pulse became exceedingly slow. Dr. John Thomson mentions a case of compression from fracture with depression, where it fell to thirty-six in a minute; and I had an opportunity of watching a case where it became as low as thirty-two. Though compression is usually characterized by the condition of pulse here described, some instances have occurred where the other symptoms have been well marked without any perceptible change of circulation. Intermission of pulse, though observed in concussion, is not met with in compression.

The symptoms affecting the alimentary canal are, that there is loss of the power of swallowing from paralysis of the muscles of deglutition; the bowels are constipated, and from the sphincter ani being paralysed, the fæces are passed involuntarily. Vomiting, which is usual in concussion, is very rare indeed in compression, it is only present under one or other of the following circumstances, namely, at the commencement of slightly marked cases, where it is probably owing more to concussion than compression; and in severe cases of compression on the sudden removal of the cause of pressure, as on the removal of the depressed portion of the bone. Vomiting indicates a greater degree of sensibility and irritability than are generally met with in compression.

The bladder being paralysed cannot pass off the urine. Unless death soon follows, this retention of urine, as pointed out by Desault, is succeeded occasionally by a dribbling or sort of incontinence of urine; for the bladder becomes so enormously distended that the urine forces the sphincter to such an extent as to allow a small quantity to dribble off, yet not sufficient to relieve the distension, or to obviate the necessity of the introduction of the catheter.

Convulsive twitches are sometimes met with in individuals suffering under compression of the brain; but, according to Bichat and Brodie, they are not indications of compression, but are believed to be more frequently connected with laceration or wound of the brain than with any other condition.

Manner in which Compression proves Fatal.—In describing the symptoms of compression it has been already stated that it proves fatal by failure of respiration, or in other words by asphyxia. All sensibility being destroyed, the sensation caused by the presence of venous blood in the lungs, which is the stimulus to respiration, is not felt; the muscles of respiration are also paralysed. After death, the veins leading to the right side of the heart, the right side of the heart itself, and the trunk and branches of the pulmonary artery, are found greatly distended with venous blood, and the left side of the heart is empty. These conditions depend on the obstacle to the transmission of blood through the lungs caused by the failure of respiration. This is a different state of parts from what was described in cases where concussion proves fatal by failure of the heart's action.

There is another circumstance in which the state of the heart differs very much in death from compression, and death from concussion.

In concussion, the heart's action seems to be completely destroyed, so that it cannot be excited to contract, although the chest of an animal be opened immediately after death, the irritability of the organ being destroyed; whereas in compression, if the heart, whose action in this form of death by asphyxia continues for a few seconds even after the last breath, be exposed immediately after death, it may be excited to contract, either by allowing some of the contents of the right side to escape, or by irritating it; thus showing that its irritability is not destroyed, as it is in death by concussion beginning at the heart. In compression, the action of the heart ceases at last, the right side being unable to contract from over-distension, and the left from the want of its ordinary stimulus, the blood.

Causes and Treatment.—The causes of compression from injury are three: fracture with depression, extravasation of blood, and the formation of matter. For a description of the symptoms, diagnosis, and treatment of these three different conditions, I beg to refer to the sections on fracture with depression, and fracture of the internal table. I think it necessary here only to add, that extravasation may take place in any of the five following situations: first, between the cranium and dura mater; second, under the dura mater into the cavity of the tunica arachnoidea; third, between the tunica arachnoidea and pia mater; fourth, between the pia mater and the brain; and fifth, into the substance of the brain itself. There does not seem to be any difference in the symptoms, whatever be the situation of the blood; and it is only when in the first-mentioned situation that relief can be given by trephining, because, in addition to other reasons, it is then only that its situation is circumscribed. I am aware of some extraordinary cases, where relief has been afforded by puncturing the dura mater; but notwithstanding these exceptions, the above, as a general rule, will be found to be correct. When suppuration takes place, it may be in any of the above-named situations. According to Pott, when the matter is between the cranium and dura mater, its existence is indicated by a puffy tumour of the scalp, and a separation of the pericranium from the outer table of the cranium. This condition does occasionally present itself, but it certainly is not an invariable symptom, as cases have occurred in which this condition was not present, and yet on dissection matter was found between the cranium and dura mater. That such is the case, Bichat says is proved by daily experience at the Hôtel Dieu.

CONDITIONS WHICH JUSTIFY THE OPERATION OF TREPHINING.

From what has been stated regarding injuries of the head, it will appear that operative interference is thought to be justifiable under the following circumstances:—

1. In simple fracture with depression, provided the symptoms persist after the use of depletion, purging, and the other alleviating remedies.
2. In compound fracture with depression without symptoms of compression.
3. In punctured fracture without symptoms of compression.
4. When the symptoms are very urgent, and the surgeon thinks he has good reason to believe, that they are caused by blood or purulent matter underneath the cranium and above the dura mater, or by fracture with depression of the inner table.

In each of the first three conditions, it is considered necessary to adopt proceedings for raising the depressed portion of bone to its proper level. If, on exposing the fracture, it is found that this cannot be done by means of the elevator, which is often the case, in consequence of the fractured portions being so related that it is impossible to insinuate the extremity of the elevator underneath the depressed portion, then it is advisable to remove a small portion of the cranium by means of the trephine, for the purpose of allowing the introduction of the elevator, by which the depressed part is to be raised. The instrument used by the ancients was the trepan, and the operation was called trepanning;

the instrument now used is called the trephine, and the operation, trephining.

Such are the views now entertained in these later and better times of surgery, as to the conditions which justify and require the operation of trephining. We find, however, from the history of surgery, that a very different doctrine prevailed in former days;—that so great was the rage for trepanning among the ancients, that the very slightest fissure, or even the mere suspicion of one, was considered to be sufficient warrant for the operation;—that they trepanned in all fractures, whether attended by depression or not, whether accompanied by symptoms of compression or otherwise;—that they operated when bad symptoms were present, to remove them,—when absent, to prevent them; so that they elevated every depression, trepanned every fracture, and, in operating on a longitudinal or a radiated fracture, they trepanned along the whole of its course, so as to saw it out; and did not allow a single fissure of it, or rima, as they called it, to escape. In operating for the removal of a coagulum, they made as many openings as would uncover, if possible, the whole of it; and, says Ravaton, “I have seen surgeons so infatuated, so desperately bent on discovering abscess on the dura mater, that, after applying six crowns of the trepan, they would, and I verily believe have, pulled away all the remaining bones of the cranium, had not their patients been delivered by death from such operations.” All this was done, they said, to remove danger. It is almost incredible to what a disgraceful extent this passion for trepanning was allowed to outrage common sense; and it is difficult to imagine how they could believe a fracture to be so dangerous, and their operations so safe. To show the extent to which trepanning was carried, Mr. John Bell gives the following quotation :—“Godifredus, Chief Surgeon to the States of Holland, mentions with particular exultation the performance of this operation by his friend, who trepanned the cranium of the Count of Nassau twenty-seven times, and that the fact might be established on indisputable authority, he made the said Count of Nassau, after he was recovered, write the following curious certificate, on the 12th day of August, 1664 :—‘I, the undersigned, Philip Count Nassau, hereby declare and testify, that Mr. Henry Chadbourn did trepan me in the skull twenty-seven times, and after that did cure me well and soundly.’” These practices, and the numerous inventions of instruments for cutting the skull, are sad monuments of the surgery of past ages. In later times the Royal Academy of Surgery in France revived and defended the doctrine that all fractures of the cranium ought to be trephined. It does seem surprising that this body of men, convened for the purpose of ascertaining the principles which ought to regulate the practice of our science, and to whom surgery is in other respects so greatly indebted, should, by giving the sanction of their high authority to so dangerous a doctrine, have led the younger members of our profession to adopt very dangerous rules of practice. The unfortunate results of the operation were so numerous, that the celebrated Desault, one of the greatest ornaments of surgery in France, forming his opinion from what he saw at the Hôtel Dieu, strongly condemned the practice, and, in the latter part of his life, entirely discarded it. The doctrine of the French Academy

met with a most powerful advocate in this country, in the late Mr. Pott, who, with all the great talent and decision for which he was so eminently distinguished, maintained the doctrine of trephining in almost every fracture, to prevent as well as to remove bad symptoms. He states that fracture of the skull in many cases is not attended with any symptoms actually demanding this operation at the moment; but that although there may be no symptoms denoting affection of the membranes, or of the brain itself, yet inflammation of those parts will, in consequence of the fracture, come on at a more or less remote period, and that, therefore, recourse ought to be had to the operation. Mr. Pott, in speaking of the doctrine of trephining, says, "I am as much convinced of this as of any fact which repeated experience may have taught me," and throughout his writings on that subject, he gives his opinion with so much decision, supporting it by cases and arguments, that his views cannot fail to have produced a very decided impression. Notwithstanding, however, all the eloquence and talent with which he supported his views, the doctrine he taught is now abandoned; and in these later and milder times of surgery, operative procedure is considered justifiable only under the circumstances mentioned at the commencement of this section.

[FRACTURES OF THE FACE.

FRACTURE OF THE BONES OF THE NOSE.

Causes.—Owing to the prominence of the nose, the nasal bones are much exposed to fracture. It generally requires considerable force to break the arch formed by the articulation of the nasal with the superior maxillary bones. Direct blows, or severe falls, are the most common causes of the accident.

Symptoms.—In many cases the contusion of the neighbouring soft parts is so great as to produce great swelling, and diagnosis is not always easy immediately after the fracture; but even if crepitus cannot be distinguished, the mobility of the parts will often be characteristic. Bleeding from the nose, and injury of the brain, may also be present. The injury of brain is apt to be from concussion, rather than from compression. If the inflammation be great, there may be exfoliation of the bones of the nose, or the inflammation may extend to the dura mater, which will produce deep-seated pain in the neighbourhood.

Nature of the Displacement.—If the fracture is simple, the displacement would be slight, and but little deformity would result; but if the bones are crushed, the bridge of the nose will be destroyed.

Treatment.—This will depend upon the amount of inflammation and the displacement. Should the fracture be simple, antiphlogistic measures may be all that is necessary; but if the bones are crushed and pressed in, they must be adjusted by a large probe, or a female catheter. Compresses applied on each side of the nose, may be of use in retaining the fragments in apposition. Stopping up the nostrils with plugs of lint, or any other material, will be found of no service; on the contrary, they will be more likely to do harm by increasing the inflammation.

FRACTURE OF THE MALAR BONE.

Causes.—This bone is rarely fractured, unless from great violence, which will also produce great contusion of the soft parts. It is easily recognised, unless the swelling be very great.

Treatment.—The swelling and inflammation are to be removed by appropriate remedies. The jaw must be kept perfectly quiet, which can be best effected by Barton's bandage for fracture of the lower jaw. The patient should not speak nor masticate. Should fragments of broken bone be driven into the temporal muscle, which would interfere with chewing, it might be necessary to cut down upon the fracture and elevate the pieces of bones.

When small portions are split off from the edges of the malar bone, they are frequently reduced in size, by absorption, previously to their uniting.

FRACTURE OF THE UPPER JAW.

The superior maxillary bone is sometimes fractured at its nasal process, in connexion with fractures of the nose. Its alveolar processes are also liable to fracture, though the injury is not a serious one, unless it is the result of a gun-shot wound, involving the antrum Highmorianum.

Fragments of alveolar processes will sometimes unite if properly pressed to their place, and the jaw be kept at rest.

Fracture involving the antrum, would be attended with great swelling and pain, and the inflammatory symptoms would require antiphlogistic remedies.

FRACTURE OF THE LOWER JAW.

This results from direct violence, which must be very considerable to produce a fracture in a bone which is so strong and at the same time so mobile. The seat of fracture may be in the body, rami, or processes, and it may happen that the fracture will occur at the symphysis, although this is rare even in children. The direction of the fracture may be either vertical, horizontal, or oblique. A portion of the alveolar process may be broken, without any serious inconvenience. The most frequent situation of the fracture is between the symphysis and the insertion of the masseter muscle.

Symptoms.—There is no difficulty in the diagnosis. The history of the case, the pain upon moving the jaw, the unevenness of the base, the

Fig. 56.



irregularity of the teeth, and the crepitus, are sufficient. The larger fragment, to which the chin is attached, will be found to be drawn downwards. If the fracture is double, the displacement will be greater, and the middle portion, or chin, will be drawn downwards. The gums are frequently lacerated, and bleed.

When fracture occurs in the neck of the condyloid process, it is not so easily recognised. In the accompanying wood-cut, taken from Fergus-

son, there is represented a fracture of both condyles. It is to be distinguished by the pain near the ear, by crepitation, and by the condyle being drawn forward by the action of the pterygoideus externus muscle.

Treatment.—The fragments are generally coaptated without difficulty in single fractures; but in double fractures, more care is required. In either instance, the great object is to keep the lower jaw firmly pressed up against the upper, which acts as a splint. A simple dressing consists of a moistened piece of pasteboard, moulded to fit the jaw, and secured by a four-tailed bandage, which has a slit in its middle, into which the chin is placed. The two upper tails are to be tied behind the neck, and the two lower ones tied upon the crown of the head. In young persons, and in double fractures, it will sometimes be found convenient to fasten the teeth together with strong silk, or fine silver wire. In many cases it will be sufficient to place a large, thick compress under the chin, and apply Barton's bandage. It consists of a roller, five yards long and two inches wide. "Place the initial extremity of the roller upon the occiput, just below its protuberance, and conduct the cylinder obliquely over the centre of the left parietal bone to the top of the head; thence descend across the right temple and the zygomatic arch, and pass beneath the chin to the left side of the face; mount over the left zygoma and temple to the summit of the cranium, and regain the starting point at the occiput by traversing obliquely the right parietal bone; next wind around the base of the lower jaw, on the left side, to the chin, and thence return to the occiput along the right of the maxilla; repeat the same course, step by step, until the roller is spent, and then confine its terminal end."

If the parts are kept perfectly quiet, union takes place readily in four or five weeks, there being abundant vascular supply; and usually no deformity results. The patient is to be nourished by fluids, and there is usually room enough for soups and gruels to find their way into the mouth through the interstices of the teeth. Some surgeons recommend the introduction of thin pieces of cork on each side between the molar teeth, leaving an aperture between the incisors sufficient for the introduction of food or medicine by a small spoon.—Ed.]

Fig. 57.



Fig. 58.



CHAPTER VII.

DISLOCATIONS.

By a dislocation is meant the removal of the articular surface of a bone from the part with which it is naturally in contact. For rightly understanding and successfully treating dislocations, it is absolutely necessary to have a thorough acquaintance with the form and relations of the bones at their extremities, the position of the ligaments, and the attachments and actions of the surrounding muscles. As to the importance of anatomical knowledge in order to understand these injuries, two great surgical authorities have thus expressed themselves:—"There is necessary," says Sir Astley Cooper, "a considerable share of anatomical knowledge, to detect the nature of these accidents, as well as to suggest the best means of reduction, and it is much to be regretted that our students neglect to inform themselves sufficiently of the structure of the joints. They often dissect the muscles of a limb with great neatness and minuteness, and then throw it away without a proper examination of the ligaments, the knowledge of which, in a surgical point of view, is of infinitely greater importance; and from hence arise the numerous errors of which they are guilty, when they embark in the practice of their profession; for injuries of the hip, shoulder, and other joints, are scarcely to be detected but by those who possess accurate anatomical knowledge." Mr. Percival Pott, in his works, observes, "In both fractures and dislocations a perfect knowledge of the disposition, force, attachments, and uses of the muscles, at least those of the limbs, is absolutely and indispensably necessary; and if the young students would be careful in attending to the plain and obvious parts of anatomy; if they would with their own hands dissect the muscles, tendons, blood-vessels, and nerves; if they would examine minutely the structure, dispositions, and connexions of all the parts which form the various joints, with their ligaments, and attend to the effects which the actions of the muscles and tendons connected therewith must necessarily have on them, they would have much more precise and adequate ideas of luxations than many of them have; they would have ideas of their own, not taken upon trust from writers, who for ages have done little more than copy each other; and they would act with much more satisfaction to themselves."

There are few bones in the body that may not be displaced by the application of enormous force; but there are some,—as, for example, the vertebræ, and the bones of the pelvis, carpus, and tarsus, so firmly joined together, that although by extreme violence the ligaments and

other structures by which they are so powerfully tied together and maintained in their natural relations, may be injured to such an extent as to admit of the bones being displaced, yet the application of extreme force in such cases produces other effects of so dangerous and destructive a character that the separation of the bones is a matter of inferior importance. The articulations which are principally subject to dislocation are the ginglymoid, and the orbicular; more especially the latter. The reason of this difference will at once be perceived on observing in the ginglymoid joints the mutual correspondence of the eminences and depressions of the bones, the number, strength, and firmness of their ligaments, and the configuration of the parts, which, like a hinge, admits of motion only backwards and forwards in a single plane; whereas, in the orbicular joints, the very shape of the bones, the comparatively loose condition of the ligaments, and the formation of the joints so as to allow very extensive and diversified movement, all contribute to increase the liability to dislocation.

Dislocations may be complete or incomplete, accidental or spontaneous; that is, the articular surfaces may be either completely, or only partially separated from each other; they may be caused by external violence, when they are called accidental, or, in consequence of disease in a joint, the bones and ordinary ligamentous restraints may be so destroyed, that the common actions of the muscles produce the displacement of the bones without any external violence. This spontaneous dislocation is met with in the hip and in the knee; but, as in this part of the work we are considering the separation of the ends of bones caused by external violence, we shall defer any further reference to spontaneous dislocation until we come to describe the phenomena connected with the diseases of joints. An incomplete dislocation is of comparatively very rare occurrence in the orbicular joints, but in the ginglymoid it is frequent, from the very great breadth of articulating surfaces.

Another arrangement, which in a practical point of view is of great importance, divides dislocations into two classes, simple and compound. A dislocation is said to be simple, when the articulation is not laid open, and compound, when the head of a bone is not only dislodged from its articular cavity, but forced through the integuments, or complicated with a communicating wound of the soft parts extending into the joint.

In treating of simple dislocations we shall consider—

- I. The causes of dislocation.
- II. The symptoms.
- III. The general indications of treatment.
- IV. The consequences of an unreduced dislocation.

I. The *Causes* of dislocation may be arranged into predisposing, and exciting. To the former belong shallowness in the form of a joint; great looseness of its ligaments; great latitude of motion; weakness of surrounding muscles, whether from emaciation and debility, or from paralysis; weakness and relaxation of the soft parts from previous dislocations; unusual distension of a joint from an inordinate accumulation of synovia; and destruction of the ordinary organs of relation from dis-

ease. The exciting causes are external violence and excessive muscular exertion. Of these many examples might be given. External violence may be applied directly or indirectly; for an example of each we may mention two ways in which the shoulder is dislocated. Dislocation downwards of the shoulder is sometimes produced by violence applied to the upper part of the humerus, by which the head of the bone is directly forced down into the axilla; and sometimes by the indirect application of violence, as when by a fall, or by other means, the elbow is forcibly raised upwards, and the head of the bone is thus driven against the under part of the capsular ligament. The displacement of the patella will furnish an illustration of the manner in which excessive muscular action may give rise to dislocation. The natural position of the patella is such that it prevents the fibres of the rectus muscle from going in a straight direction from their origin at the pelvis to the anterior tuberosity of the tibia, into which they may be considered as being inserted through the medium of the fibrous covering on the front of the patella and the ligamentum patellæ. The bone, preventing these fibres from going in a straight direction from the pelvis to the leg, causes them to describe an arch, the convexity of which is inwards. When the muscle is violently called into action, it will have a tendency to draw the patella outwards, in its endeavour to pass straight to the tibia, and thus a dislocation outwards is often produced. If the muscle be violently called into action while the knee is bent inwards, a dislocation will be still more likely to ensue. At the temporo-maxillary articulation, a dislocation is often caused by muscular contraction, as will be afterwards explained.

II. *Symptoms*.—One of the most constant and characteristic symptoms of dislocation, and one which seems to distinguish this injury from fracture, is the fixed condition of the limb. In some cases there is absolute immobility of the limb, so that it can neither be moved by the voluntary efforts of the patient, nor even by the surgeon. This complete immobility is usually found in joints which move only in a single plane; for example, it is particularly observed in dislocation backwards of the elbow. In other instances, although the muscles about a joint cannot excite motion, the limb may be very slightly moved in one particular direction; for instance, in some cases of dislocation downwards of the humerus into the axilla, the arm can be raised upwards to a certain extent by the surgeon, while it may be perfectly immovable in every other direction. But slight mobility in one direction, though occasionally observed, is not found in many instances, and therefore a fixed condition of a limb may be considered as a general symptom of dislocation. Sometimes the mobility is not entirely lost for two or three hours, or even longer, after the accident. This is believed to arise chiefly from the muscles requiring some time to shorten and accommodate themselves to their altered condition, and partly from the irritation and inflammation caused by the unnatural position of the bone. The patient feels more pain and tenderness in consequence of the irritation and inflammation, and, therefore, naturally offers greater resistance to any moving of the limb. A second symptom particularly deserving notice, is the unnatural direction of the axis of the bone. This is a striking

symptom, and to be especially observed. As a good example we may mention dislocation downwards of the shoulder, in which the axis of the humerus is directed into the axilla, instead of being in its natural position. This symptom presents itself immediately on the occurrence of dislocation, and remains until reduction is effected. A third, and very frequent symptom, is some alteration in the length of the limb. The dislocated extremity is in most instances shortened, but is sometimes lengthened; as, in dislocation downwards of the shoulder, and dislocation downwards of the hip. In the under extremity, the presence or absence of this lengthening is a good diagnostic symptom between dislocation and fracture; for it is found in dislocation downwards of the hip-joint, but never occurs in any fracture of the under extremity. A fourth symptom is some unnatural appearance about the joint, by which its shape is changed. These alterations of form differ, of course, in different dislocations. A fifth symptom is slight, soft crepitation, or a simulation of crepitus. This is a symptom of which the practitioner ought to be well aware, lest he be deceived by it, and led to mistake a dislocation for a fracture. The crepitation in dislocation is of a soft, crackling, oozy, sloppy character, easily distinguished from the hard grating crepitus of fracture, and is supposed to arise from the escape of synovia, and serous effusion, into the surrounding cellular tissue. Sometimes, however, there is in dislocation a hard crepitus, in consequence of small osseous scales being torn off from the bone, where the muscles are inserted into it. In addition to the above symptoms there are sometimes great swelling, pain about the joint, great pain at the extremities of the nerves, the trunks of which may be pressed by the head of the bone. There may also be numbness, or even paralysis of the limb, if the pressure on the nerves be to a great extent, and oedema, if the pressure be on the vessels returning blood from the extremity.

III. Treatment.—In the treatment of dislocations the indications are three:—

1. To restore the bone to its natural situation:—this is termed reduction.
2. To preserve the parts reduced in their natural position, until the lacerated ligaments have had time to unite.
3. To prevent unfavourable symptoms, or, if they have already occurred, to remove them.

The first and paramount indication is reduction, which should be immediately attempted; for it becomes increasingly difficult with the length of time from the occurrence of the dislocation, and is, after a long interval, altogether impracticable. It is universally agreed that the chief impediment to the reduction of a recent dislocation is muscular action. Some muscles, having their extremities brought nearer to each other than is natural, become permanently contracted, and accommodate themselves to their new condition. The proofs of this are found in the facility with which reduction is accomplished, when the accident has happened in a limb affected with paralysis, or in a weak, relaxed, and emaciated person; or when the muscles are incapable of making much resistance through any great temporary weakness, or extreme prostration, or collapse, or through the patient being faint or debilitated by bleeding,

nausea, or other means. Additional proof that muscular action is the chief impediment to reduction, is given in the fact, that if the mind of the patient be diverted from the accident, and be directed to other subjects, while attempts are being made to accomplish reduction, the surgeon's design is more easily effected, the muscles are then taken, as it were, by surprise; but if the attempt be made while the mind of the patient is on the watch, the muscles will resist with their utmost power, and great difficulty will be experienced. These facts furnished useful hints in practice, and suggested the property of various means employed in difficult cases to increase the efficiency of the methods adopted for accomplishing reduction.

The condition of the parts about the joint differs at different periods, if it be long before reduction is attempted. Immediately after the accident, the muscles are relaxed from the depression of the system, principally caused by the shock of the injury, and this condition is very favourable for reduction; soon, however, they become spasmodically rigid, and ultimately, if reduction be not accomplished, they become completely adapted to their altered condition; the laceration of the ligaments is gradually filled up by the effusion of adhesive lymph, and if the ligament be a capsular one, with a rent, through which the head of the bone has escaped, the diminished size of this opening from the effusion of lymph will, in time, present a further obstacle to the return of the bone into its natural situation. To overcome the contraction of the muscles, extension and counter-extension are employed. It must be manifest that simply drawing or extending the limb would not have much effect on the muscles around the joint, but that to make the whole force bear upon them, both extension and counter-extension are to be used. For instance, when you have to reduce a dislocation of the shoulder, you first fix the scapula; in other words, you use counter-extension. You next apply the extending force to the arm; but this, without counter-extension at the same time, would answer no useful purpose, for the extending force, instead of acting on the muscles around the joint, would act on the whole body; so that counter-extension, that is, the fixing of the body, is obviously just as necessary as the application of force to the bone which has been dislocated.

By British surgeons, extension and counter-extension are applied as near as possible to the dislocated joint: for example, in dislocation of the hip, the counter-extension is applied to the pelvis, and the extension to the thigh; because the whole force is thus directed against the muscles, which oppose the reduction. In France, this practice is objected to, on the ground that the muscles which have to be stretched, must, in extension, be irritated by the pressure, and excited to contract, thereby offering increased resistance to the accomplishment of reduction. The French apply extension at a distance from the dislocation; for example, in reducing a dislocation of the hip-joint, the extension is applied to the leg, not, as in this country, to the thigh.

A point of considerable importance is, the best method of using extension; whether short and violent efforts should be made, or whether the force should be continued even and uninterrupted. On this subject Professor Samuel Cooper remarks:—"The invariable maxim in reducing

dislocation is, not to make the extension with sudden and considerable violence, but gradually, and, at the same time, steadily and unremittently. It is safer to tire out the opposition of the muscles by gradually-increased uninterrupted force, than by resorting to short efforts of great violence. In this latter practice you run the risk of producing considerable mischief; you may rupture arteries and veins; you may contuse and injure important nerves; or you may lacerate the soft parts. But with all these objections, you will gain nothing, for you would have less chance of getting the bone into its place, than by a milder and more judicious plan. The principle, I repeat, then, is to make the extension slowly and gradually, and at the same time unremittently; for no muscles, however powerful they may be, can resist force thus employed against them, beyond a certain time, and they must, eventually, become tired out." The manner in which extension and counter-extension are employed, varies in different dislocations, as will afterwards be observed, when the dislocations are described.

In employing extension, the greatest care is necessary so to apply it that the injury to the soft parts may be as little as possible. With this object, various means are taken to avoid bruising or excoriating the part to which the force is applied; a few turns of a roller, wetted, that it may be less apt to slip, or a portion of soft wash-leather, or a damp towel, may for this purpose be put round the part to which the extension is to be applied. This having been done, let a loop, or noose, formed by doubling a band of linen, or, which answers as well, of stout worsted, be fixed on the part of the limb thus protected, and the ends be drawn through the noose; to these ends the force employed, which is usually the muscular power of assistants, is applied. The preferable way of applying the noose, is to fix it by means of what is called the clove-hitch; the advantage of which is, that while it holds firmly enough, it cannot be tightened by the pulling so as unduly or dangerously to constrict the limb. Instead of a noose, a circular band, tightened by a screw, is sometimes used, but the former is more convenient and efficient. The force should be thus applied, while counter-extension is being employed above the joint. The different ways of using counter-extension suitable to special dislocations will be afterwards described.

In some dislocations the muscular power of assistants is insufficient; and in such cases the necessary force is applied by means of pulleys. These, being so constructed as to afford great mechanical power, enable the operator to carry the extension to any degree he may think judicious, without the risk of any relaxation or diminution of the force. When they are employed, a well-padded belt is fixed round the limb, having two straps with rings attached to them; the hook of one set of pulleys is fixed to the rings, while the hook of the other set is fixed to some ring, staple, or other resisting object in the room, and an assistant pulls the cord, to which in this method of reduction the whole power is applied.

[Dr. Gilbert, Professor of Surgery in the Pennsylvania Medical College, has suggested a very simple yet effective means of applying an extending force in dislocations. He thus describes it: "Place the

patient, and adjust the extending and counter-extending bands as for the pulleys ; then procure an ordinary bed-cord or a wash-line, tie the ends together, and again double it upon itself, pass it through the extending tapes or towels, doubling the whole once more, and fasten the distal end, consisting of four loops of rope, to a window-sill, door-sill, or staple, so that the cords are drawn moderately tight ; finally pass a stick through the centre of the doubled rope, then by revolving the stick as an axis or double lever, the power is produced precisely as it should be in such cases, viz., slowly, steadily, and continuously."—Ed.]

The obstacles to reduction are sometimes so considerable that it is necessary to employ some previous measures to diminish the power of the muscles. This is usually required in attempting to reduce dislocations of long standing or in robust persons, and in dislocations of the hip-joint, where the resistance is always very considerable. The means formerly employed for this purpose were, venesection, or nauseating doses of antimony, or the warm bath. Of these the former two are the most powerful. When the patient is faint or sick, reduction is much more easily accomplished ; and if the patient be robust, or the resistance very great, there is much less risk in having recourse to either of these means than in employing the greater force, which would otherwise be necessary. Of all the auxiliaries to extension and counter-extension, chloroform is the most powerful, and it is now invariably preferred. It prevents pain, facilitates reduction, renders comparatively little force necessary, thereby diminishing the danger of injuring texture, and it leaves no permanent weakness of system. When extension and counter-extension are being employed, the surgeon should use the dislocated bone as a lever, and endeavour to press the extremity of it in the direction most calculated to promote reduction ; but this should not be attempted until extension and counter-extension have been used for some time.

For fulfilling the second indication, that is, to prevent the recurrence of dislocation until the ligaments have had time to unite, the joint should be kept at rest, in the attitude in which a return of the dislocation is least likely to occur in some instances, and with a degree of support, which, however, must depend on the situation of the articulation. The ligaments are more or less lacerated, and require time to heal ; and the surrounding muscles, being not unfrequently torn from their insertions, must be kept at rest until they regain their attachments, otherwise the joint will remain weak in after life.

The third indication is to prevent, or remove unfavourable symptoms ; for the former purpose, rest of the joint and the antiphlogistic regimen are required ; for the latter, antiphlogistic remedies proportioned to the age and strength of the patient, and the violence of the symptoms.

IV. *The Consequences of an Unreduced Dislocation* are important, and in some instances the resources of nature in forming an artificial joint are considerable. They seem, however, to be much more effective in some articulations than in others ; in the orbicular, for example, than in the ginglymoid. In the one case, the power of motion is often

¹ Amer. Jour. Med. Scien., No. II.

regained to a considerable extent, whereas in the other, it is almost, or sometimes even entirely lost. In orbicular joints the very form of the bone gives a facility of moving, and if the displaced head rests on a muscle, the muscle becomes dense, hollow, ligamentous, smooth, lubricated, and of a suitable form for its reception. If it rests on a bone, as, for example, on the ilium or scapula, a cavity is formed to receive it, partly by absorption of part of the bone on which it rests, and partly by the deposition of new bone; and the cavity is either lined with a dense ligamentous matter, or covered with a porcellaneous deposit. A cup is thus formed for the reception of the head of the displaced bone, which loses its cartilage, and generally becomes covered over by the porcellaneous deposit, which gives a smoothness to the movement of the parts on each other. The surrounding cellular tissue becomes condensed, and, although less dense and firm than the original capsular ligament, yet it serves to connect the parts of the new articulation with each other, and assists in preserving them in the necessary relations. Subsequently, but always after the lapse of a considerable period, the original cavity for the reception of the head of the bone becomes changed and ultimately very much diminished by the disappearing of its cartilage, the gradual filling up of its centre, and the rounding off by absorption of its edges. These changes take place earlier, if the new cavity be so situated as to encroach during its formation on the old one. In some cases the new cavity has been found so completely to surround the head of the bone, that it was impossible after death to remove the head without fracturing some part of the artificial joint. The resources of nature in remedying the effect of an unreduced dislocation are by no means so great, when the accident occurs in a ginglymoid articulation. The configuration of the bones is such, that the displaced bone cannot play so easily on the parts with which it is brought into contact; and the bones are held so firmly by their connexions as not to admit of much motion; hence, more or less of bony ankylosis has been found, on dissection, to be the general result. It is evident, therefore, that the consequences of an unreduced dislocation materially differ according to the nature of the articulation to which the accident has happened.

COMPOUND DISLOCATIONS.

When a bone is not only displaced from the articular surface with which it is naturally in contact, but is also protruded through the external coverings, or when, in addition to displacement, laceration exposes to view the cavity of the joint, the injury constitutes a compound dislocation, which bears the same relation to simple dislocation as compound fracture bears to simple fracture. A compound dislocation may also be complicated with fracture or severe contusion of the bones, extensive laceration of the soft parts, rupture of blood-vessels, or laceration of, or pressure upon, nerves. These complications are very formidable, and excite the greatest anxiety in the mind of the surgeon. At one time these were considered cases for amputation; but now a surgeon would not think himself justified in advising amputation from the mere circumstance of a dislocation being compound. Petit and Pott inculcated the necessity of immediate amputation, and the

practice was for a long time almost invariably adhered to, both in this country and in France; but the experience of Sir Astley Cooper, the late Mr. Hey of Leeds, Mr. Lawrence, and of almost every practical surgeon of eminence in the present day, justify a different procedure. In determining on the necessity of amputation, the surgeon is guided by the extent and nature of the complications, the situation and size of the articulation, and the constitution of the patient. The circumstances which warrant amputation are,—very serious complications, such as dangerous contusion, and extensive, and more especially comminuted, fracture; rupture of important arteries; very great laceration of soft parts, so that the joint is to a great extent laid open; and a weak or irritable constitution. The case is also more unfavourable, if the articulation be in a part of the body where, by reason of the distance from the centre of circulation, the process of repair must be feeble. Such are the general considerations to be taken into account in judging of the propriety and necessity of amputation; but in every particular instance, the surgeon must be guided by the particular circumstances, as it is impossible to lay down such a general rule, as would enable him to determine in every case that may arise. When amputation is deemed necessary, the proper time for its performance is immediately after the patient has recovered from the collapse caused by the injury, and before inflammatory symptoms and accompanying irritative fever have commenced. The only other period at which it can be performed is not only much less favourable, but is also one which may never arrive; namely, when the above symptoms have subsided. The question, therefore, whether or not a limb is to be preserved, is one which calls for an early decision. When such cases terminate fatally, it is usually either at an early period by gangrene, or by irritative fever, or, at a later period, by hectic fever from the continuance of local suppuration and irritation. After the subsidence of the irritative fever, while the patient is hectic, amputation may be performed: but after the constitution has been weakened by the previous symptoms, it is with much less prospect of a favourable result. The two dangers which the surgeon has to consider in determining the treatment in the first instance are, on the one hand unnecessary mutilation if the limb be amputated, and on the other, the risk of life from gangrene and irritative fever, if amputation be not performed. In persons of sound constitution compound dislocation is often treated successfully, and sometimes they recover from very formidable injuries of this description with very considerable motion of the injured joint.

When an attempt is to be made to save the limb, the bones should be reduced, the edges of the wound brought together, and preserved in apposition by strips of adhesive plaster, applied in such a manner as not to excite by any irritation by pressure; every effort should be made to obtain adhesion of the soft parts, and the local and constitutional symptoms be combatted by the appropriate remedies.

PARTICULAR DISLOCATIONS.

DISLOCATIONS OF THE LOWER JAW, OR TEMPORO-MAXILLARY ARTICULATION.

The temporo-maxillary articulation is formed of two bones, an inter-articular cartilage, and two synovial capsules; it is furnished with three ligaments; it admits of motion upwards, downwards, backwards, forwards, and to either side.

The two bones are the temporal and lower jaw, the condyloid fossa of the former, and the condyloid process of the latter. Each bone, where it forms the joint, is covered with a cartilage of incrustation; besides which there is an interarticular cartilage dividing the articulation into two compartments,—one between the condyloid fossa and the cartilage, the other between the cartilage and the condyloid process; and each division is furnished with a distinct synovial membrane.

The ligaments are three,—the external lateral, which is in contact with bones forming the articulations, and by its deep surface adheres to the interarticular surface and synovial apparatus, thus helping to preserve the cartilage in its proper situation; the internal lateral, and the stylo-maxillary; the last two not being in contact with the articulation, but completely separated from it by several important structures.

The jaw is drawn *upwards* by the temporal, masseter, and internal pterygoid muscles; *downwards*, by the platysma-myoides, digastricus, mylo-hyoideus, genio-hyoideus, and genio-glossus muscles; *forwards*, by the combined action of the two external pterygoid, and one of the portions of the masseter; *backwards*, by the masseter, and when the os hyoides is fixed, by the digastricus, the genio-hyoideus, and genio-hyo-glossus, and perhaps very slightly by some of the fibres of the mylo-hyoideus; and *laterally*, as in the grinding motions of the jaw, by the alternate actions of the two external pterygoid muscles assisted by the oblique motion forwards given by the internal pterygoid.

The articulation is liable to three dislocations, namely—

- 1st. Complete dislocation on both sides;
- 2d. Complete dislocation on one side; and
- 3d. Partial dislocation of the temporo-maxillary articulation.

COMPLETE DISLOCATION ON BOTH SIDES.

Causes.—This dislocation may be caused by a blow upon the chin when the mouth is widely opened; by yawning; by spasmodic action of the external pterygoid muscles, while laughing; by spasmodic action of the same muscles, during the extraction of a tooth,—of which the celebrated Mr. Fox, the dentist, met with an example; or by violently or suddenly opening the mouth very wide to receive too large a body,—of which Sir Astley Cooper records a case,—two boys were struggling for an apple, and the one, in attempting to force it into his mouth, dislocated his jaw. When the condyloid process is in its natural position, it rests behind the inferior root of the zygoma, which forms the anterior part of the condyloid fossa; but it may be drawn over this root by the external pterygoid; and this is more likely to happen, if the mouth be

wide open, when the external pterygoid contracts. The rationale of this must at once be evident to every one who knows the action of the pterygoid muscles.

Fig. 59.



Symptoms.—The patient is unable to close the mouth. At first there is a considerable distance between the front teeth of the upper and lower jaw-bones, sometimes as much as an inch and a half; but afterwards the jaws can be brought closer, although the mouth still remains open, in consequence of the mechanical obstruction presented by the relation which is produced between the coronoid process of the lower jaw, and the under part of the malar bone. The functions of speech and of deglutition are interrupted; and the salivary glands being irritated by the pressure, there is consequently a great secretion of saliva, which, from the loss of deglutition, dribbles over the chin. If the

lower teeth could be brought up, they would be found much in advance of the upper. The pain in some instances is not very great; in others excessive. The cheek is stretched and flattened; the angle of the lower jaw is too near the mastoid process of the temporal bone, and a preternatural depression may be felt in front of the external auditory foramen, occasioned by the removal of the condyle from its natural situation.

State of the parts.—The condyloid process, instead of being in its natural situation, that is, in the

Fig. 60.



condyloid fossa, the articular cavity of some writers, behind the inferior root of the zygoma (called by some the articular eminence), is brought forward in front of this eminence; and as the combined action of the external pterygoid muscles, which have one of their insertions into the pterygoid fossa immediately beneath the condyloid process, is to bring forward the jaw, it is easy to perceive how the dislocation may be produced by the spasmodic contraction of these muscles.

The coronoid process of the lower jaw is inferior to the under part of the malar bone, and pressing against it, presents the mechanical obstacle to the closing of the mouth, which has been already referred to.

Treatment.—Various methods of reduction have been adopted. One

is to introduce the thumbs, and with them to depress the molar teeth, while the chin is elevated by the fingers: by this means the condyles are depressed, and sent backwards into the cavities in which they are naturally situated. Another method is that employed by Mr. Fox, who placed a piece of wood about a foot long upon the molar teeth; then raising the end which he held in his hand, and using the teeth of the upper jaw as a fulcrum, thus depressed the end which was on the teeth, thereby accomplishing reduction on one side; and afterwards, in the same manner, he reduced the dislocation on the other side. A third, and by far the most elegant method, is that recommended by Sir Astley Cooper, namely, to place a cork on each side, between the molar teeth of the upper and lower jaw-bones as far back as possible, and then to press up the chin with the hand. The corks act as fulcra, the lower jaw as a lever, and the hand applied to the chin as the power. By raising the chin, the condyles are pressed downwards and backwards, and are thus sent over the articular eminences into their natural situations.

COMPLETE DISLOCATION ON ONE SIDE.

By this is meant a dislocation in which the condyloid process advances over the inferior root of the zygomatic process, or articular eminence, on one side.

In this dislocation the mouth cannot be closed, but it is not so widely opened as in dislocation on both sides; the chin is generally twisted to the opposite side, and the incisor teeth are not in a line with the axis of the face. From a consideration of the structure of the parts we should expect, that in every instance of this injury the chin would be evidently turned towards the opposite side; but Mr. Hey, of Leeds, says (at p. 325 of his "Practical Observations on Surgery," third edition), "I have repeatedly seen the disease when I could discern no alteration in the position of the chin. The symptom which I have found to be the best guide in this case, is a small hollow, which may be felt behind the condyle that is dislocated, which does not subsist on the other." The other symptoms, the state of the parts, and the treatment, are precisely the same as in the preceding injury, except that in reduction, the cork, or lever of wood, or pressure with the thumb, should be used only on one side. To depress both condyles is found, as was first mentioned by Mr. Hey, to have a tendency to prevent reduction; and this, no doubt, explains what several surgeons have experienced, namely, that reduction is more easily accomplished by using the lever of wood, than by other means when the injury is on one side. After reduction, the jaw should be for some time supported by a bandage, and the patient should be careful not to open the mouth wide for a considerable period. Care, indeed, will be ever afterwards necessary in opening the mouth; for when the injury has once happened, a very slight cause will be sufficient to reproduce it.

PARTIAL DISLOCATION, OR SUBLUXATION OF THE JAW.

The signs of subluxation are, a sudden locking of the jaw, the mouth being opened slightly and more widely in general on the affected side,

and pain at the articulation. The symptoms do not depend on the displacement of the bones from each other, but on the interarticular cartilage slipping from its proper relation to the condyloid process in consequence of relaxation, especially of the external lateral ligament. It is met with in persons of a relaxed habit of body, and is usually removed by the natural efforts to open or shut the mouth; but when these do not succeed, the back part of the jaw should be pressed directly downwards, so that the condyloid process being depressed, the cartilage may be replaced in its proper relation to it. In one instance, after this plan had failed, remembering the attachment of the external pterygoid muscle to the interarticular cartilage as well as to the pterygoid fossa, I desired the patient to make an effort to bring forward the lower jaw, and the effort very speedily removed the subluxation. Young women of relaxed habit often experience a painful snapping at the joint while opening and closing the mouth. This, it is believed, is occasioned by the ligament failing from relaxation to preserve the parts in their due relations; and the best remedies for its removal are the means most likely to increase the tone of the parts, and to improve the general health and strength. The shower-bath, preparations of iron, together with other treatment for the general health have been useful, and in obstinate cases, a blister in front of the ear has been found to produce the desired effect.

DISLOCATION OF THE CLAVICLE AT ITS STERNAL EXTREMITY.

We have here two bones, the sternum, which is fixed, and the clavicle, which is so connected with the sternum that its inner extremity projects above it, and four ligaments, namely, the anterior sterno-clavicular, the posterior sterno-clavicular, the interclavicular, and costo-clavicular, together with an interarticular cartilage connected more closely with the clavicle than with the sternum. Of this articulation four dislocations have been known; but two of them are so extremely rare, that of one, Sir Astley Cooper, in his own vast experience, never met with an example, although he records a case occurring in the practice of another surgeon, in which the dislocation was caused, not by external violence, but by disease; and of the other, so far as my reading extends, I have found but one example. The four dislocations are arranged in the following order, according to the direction of the clavicle.

1. Dislocation forwards, in which the clavicle is thrown forwards on the sternum.
2. Dislocation upwards.
3. Dislocation backwards.
4. Dislocation upwards and inwards.

Symptoms.—In dislocation forwards there is an unnatural tumour, or obvious deformity in front of the sternum, which may be made to disappear by drawing the shoulders backwards; but it returns as soon as the force is removed; the distance between the acromion process and the mesial line is diminished; the head is drawn forwards, and turned from the affected side to relax the sterno-cleido-mastoidæus muscle; and there is inability to raise the upper extremity. The clavicle rests on

the front of the sternum. A partial dislocation in this direction has been met with, in which the clavicle is not removed from its articulation with the sternum, the ligaments not being sufficiently lacerated to admit of complete displacement; but it projects unnaturally forwards.

In dislocation upwards the symptoms differ from those of the last dislocation merely in the situation of the unnatural swelling, which in this instance is in the under part of the neck; in the other on the front of the sternum.

In dislocation backwards there is an unnatural depression in the ordinary situation of the sternal extremity of the clavicle. It may also be accompanied by dyspnœa from pressure on the trachea, by dysphagia from pressure on the œsophagus, and by impeded circulation and pain from pressure on the vessels and nerves. This dislocation is so very rare, that Sir Astley Cooper says he never met with a single case as the result of injury, but refers to a case which occurred in the practice of Mr. Davie, surgeon at Bungay, Suffolk, in which the dislocation was caused by the bone being pressed forward at its outer extremity, arising from deformity of the spine. In this case, Mr. Davie was obliged to saw off the inner extremity of the clavicle, in order to relieve the dyspnœa and the other distressing symptoms caused by the pressure on the parts at the under portion of the neck. It has, however, been since ascertained that this injury may be produced by violence, and in the "Medical and Surgical Journal" for October, 1841, several cases are recorded. The ligaments in this dislocation are more or less ruptured.

Treatment.—In dislocation forwards, the surgeon should endeavour to bring forwards the outer extremity of the clavicle, at the same time pressing backwards the inner extremity. In many instances the clavicle has been drawn off the sternum by pulling the shoulder backwards.

In dislocation backwards, it is necessary to draw the shoulders very much backwards, and as far as possible from the sternum. In all these dislocations the clavicle may be drawn outwards by drawing the shoulder outwards. In dislocation upwards, after the shoulder is drawn outwards the surgeon should raise the outer and depress the inner extremity of the clavicle. For preserving the bone in its normal situation, and at perfect rest, the best retentive apparatus is that used in fractures. The cure is seldom so complete as in dislocations of other joints, and often some deformity remains, in consequence of the ligaments not properly uniting. Professor Samuel Cooper gives the following particulars of the dislocation upwards and inwards. He says, "My friend, Mr. Morton, of University College, has favoured me with the particulars of an unusual dislocation of the sternal extremity of the clavicle, the displacement of it being upwards and inwards. Etienne Caréron, æt. 39, mason, admitted into the hospital of La Charité, on account of an injury which was caused by his having been violently squeezed between a wall and a cart, in such a manner that the left shoulder was thrust inwards with great force. On examination, the sternal extremity of the clavicle was found to have been displaced from its natural situation, and was now placed above the upper edge of the sternum, producing a slight deformity in the contour of the lower part of the front of the neck. It seemed from the description of the accident which was given by the

patient, that the force producing the injury had acted in such a direction as to push the sternal extremity of the dislocated bone upwards and behind the sternal portion of the sterno-cleido-mastoid muscle. The articular surface of the internal extremity of the dislocated clavicle lay opposite to that of the clavicle of the sound side, and was supported by the superior border of the sternum. The attachment of the sterno-cleido-mastoid muscle to the first bone of the sternum did not appear to have suffered any laceration. M. Velpeau considered it to be very probable, that the dislocation was in the first place backwards, but that the force continuing to act, the end of the clavicle was afterwards driven upwards and across the front of the root of the neck, and behind the sterno-cleido-mastoid muscle. The dislocation was reduced in the usual manner, and the apparatus of Désault for fractured clavicle employed to retain the bone in its proper place. The bandages used were steeped in a solution of 'dextrine,' which when dry rendered the whole immovable."

DISLOCATION OF THE CLAVICLE AT ITS SCAPULAR EXTREMITY.

The external extremity of the clavicle articulates with the acromion process of the scapula. The ligaments which more immediately bind these bones together are two; the superior and inferior acromio-clavicular ligaments. The two portions of the coraco-clavicular ligament, though not attached to the parts forming the articulation, still contribute much to prevent the frequent occurrence of dislocation by causing the two bones to follow each other in their motions. The scapular extremity of the clavicle is liable to only one dislocation, namely, upwards, in which it rests on the acromion process of the scapula.

Symptoms.—Diminution of the space between the apex of the acromion process and the central point of the sternum; an obvious deformity produced by the outer extremity of the clavicle, which, according to Sir Astley Cooper, may be best ascertained by tracing the spine of the scapula from within outwards; in doing which the finger will be interrupted by the outer extremity; inability of the patient to raise the arm; and unnatural flatness of the shoulder. By drawing the shoulders very forcibly backwards, these symptoms may be made to disappear for the time.

State of the parts.—The superior and inferior acromio-clavicular ligaments are ruptured. The peculiarity of the displacement is, that when the two portions of the coraco-clavicular ligaments are ruptured, the falling down of the shoulder is greater than if the two proper ligaments be ruptured.

Treatment.—The object is to bring the shoulders backwards. Sir Astley Cooper recommends the surgeon to place his knee between the shoulders of the patient, and forcibly draw them backwards and outwards. According to Mr. Liston, the best retentive apparatus is the same as for fractured clavicle; and which must be continued for many weeks, as the ligaments are slow in uniting. In dislocation of either extremity of the clavicle, even when treated by the most experienced surgeons, some deformity will almost always remain; but the patient will recover the motion of his arm.

DISLOCATION OF THE SHOULDER JOINT.

The scapulo-humeral articulation is formed of portions of two bones,—the glenoid cavity of the scapula, and the head of the humerus. The ligaments entering into its formation are three—the capsular, the accessory of some, the coraco-humeral of other anatomists, and the glenoid. An intimate knowledge of the anatomy of this articulation, and of the disposition of the muscles for effecting its movements, is of the utmost importance; for experience has proved that, in consequence of its varied and extensive movements, the shoulder joint is more frequently dislocated than any other of the articulations, and even, as some maintain, than all the others collectively. The number of dislocations to which it is liable, though usually stated to be four, we shall find to be five, three of which are complete, and two partial. The direction of the humerus is made the basis of the nomenclature.

1. Dislocation downwards, or downwards and inwards, or into the axilla.

2. Complete dislocation forwards.

3. Partial dislocation forwards.

4. Dislocation backwards.

5. Partial dislocation upwards.

With regard to the comparative frequency of these dislocations, it has been ascertained that the first occurs most frequently; the second and third are not so common; the fourth is very rare; and of the fifth, not more than one or two cases are recorded.

I. DISLOCATIONS DOWNWARDS.

Exciting Causes.—A fall from a great height upon the top of the shoulder; a blow upon the upper part of the humerus, when the arm is extended; or the forcible and violent upraising of the hand or elbow, by which the head of the bone is pressed against the under part of the capsular ligament. It has also been caused by the violent contraction of the deltoid, as in raising a heavy body; for while the deltoid raises the arm, the capsular ligament is made the fulcrum; and if this gives way, dislocation downwards may be produced.

Symptoms.—The natural roundness of the shoulder is lost, owing to the head of the bone no longer supporting the deltoid muscle; the acromion process is unusually large and prominent; and a very striking symptom, which cannot fail to be perceptible on examination, is a vacuity under the acromion. There is also a want of that depression or hollow at the insertion of the deltoid, which is very conspicuous when there is no dislocation. The fibres of the deltoid, instead of giving the roundness to the shoulder, and going in a convex direction over the head of the humerus, in their way from their origins to their insertion into the deltoid eminence, go in a straight direction; and if they be felt through the integuments, it will be found that they are not only flat, but also exceedingly tense,—a condition which, as will afterwards appear, offers one of the obstacles to reduction. The rationale of these symptoms will be easily understood, when it is remembered that the head of the bone, instead of resting, as it naturally does, in the glenoid cavity, is sent

down into the axilla, and consequently the distance between the insertion and the origins of the deltoid is greater than natural, and its fibres are therefore put violently on the stretch.

Fig. 61.



All the above-mentioned symptoms are observable about the upper and outer portion of the shoulder. On the opposite aspect of the joint, namely, in the axilla, there is an unnatural tumour caused by the head of the bone, which is rendered more perceptible by effecting abduction of the elbow. The surgeon may not be very sensible of this symptom while the patient holds his elbow as near as he can to his side: but the moment the elbow is pressed outwards, the head of the bone sinks in the axilla, and can be very distinctly felt. Elongation of the affected arm is particularly well marked; for ascertaining which, take the apex of the acromion and the outer condyle of the humerus, as two fixed points for measurement. The forearm is at a right angle with the arm and the elbow, the situation of which should be particularly observed, as it serves for a diagnostic symptom in distinguishing the different dislocations of the shoulder from each other, is neither directed backwards nor forwards, but is in a line with the long axis of the body, and removed from the side. The patient cannot, by a voluntary effort of the muscles of the affected arm, bring the elbow to the side; and if the surgeon forcibly press it inwards, the patient complains of great pain from the head of the bone being pressed against the nerves of the axilla, and when left to itself the arm hangs away from the trunk. The patient has an inclination to support the elbow by the hand, when standing; and when sitting, to rest it on the knees. A very striking symptom is an alteration in the direction of the long axis of the humerus. In the natural state of the parts when the arm is by the side, the axis of the humerus is parallel to the side, and the arm seems to come

down from the glenoid cavity; whereas in this dislocation the axis is placed obliquely in regard to the side, and the humerus seems to come out from the trunk instead of from the glenoid cavity. The patient has lost the power of performing the ordinary movements of the joint, and not only is he unable, by voluntary effort, to raise his arm: but it is also, in a great measure, immovable to the surgeon, especially upwards and downwards, remaining stiff in its unnatural position; and the patient, when he wishes to alter its situation, moves the whole trunk and extremity in mass. Sometimes the surgeon can move it slightly backwards and forwards, while in other directions, motion is difficult and attended with great suffering. It is proper, however, to add, that in very old persons, or in relaxed feeble habits of body, the immobility of the arm to the surgeon may not be so perceptible. In addition to the above symptoms, there is often tingling at the points of the fingers, with numbness of the whole limb, and oedematous swelling arising from the compression of the axillary plexus and interruption of the circulation. On moving the limb a slight crepitus is sometimes perceived, but on continuing the motion it ceases to be perceptible. The crepitus is, probably, owing to the effusion of serum, and the escape of synovia into the cellular tissue. This soft crepitus is easily distinguished from the hard crepitus of fracture, which, however, has been sometimes met with in dislocation of the shoulder, and is believed to depend on one or more of the tendinous attachments of the muscles having, during their disruption, torn away a portion of their osseous attachments. Many of these appearances, although very distinctly marked at first, frequently become obscured for a time by extravasation of blood and inflammatory swelling, which often supervene; but when these symptoms subside, they again become distinct and decisive.

State of Parts.—For conveying to the reader an idea of the state of the parts, I shall give the result of two dissections by Sir Astley Cooper, one by Sir Philip Crampton, and one by myself. Sir Astley Cooper says,—“I have dissected two recent cases of this dislocation. A sailor fell from the yard-arm on the ship’s deck, injured his skull, and dislocated the arm into the axilla; he was brought into St. Thomas’s Hospital, and expired immediately after he was put to bed. On the following day I obtained permission to examine his shoulder, which I removed from the body for the purpose of obtaining a more minute examination, and the following were the appearances which I found. On removing the integuments, a quantity of extravasated blood presented itself in the cellular membrane, lying immediately under the skin, and in that which covers the axillary plexus of nerves, as well as in the interstices of the muscles, extending as far as the cervix of the humerus below the insertion of the subscapularis muscle. The axillary artery and plexus of nerves were thrown out of their course by the dislocated head of the bone, which was pushed backwards upon the subscapularis muscle. The deltoid muscle was sunken with the head of the bone; the supra and infra-spinati were stretched over the glenoid cavity and inferior costa of the scapula. The teres major and minor had undergone but little change of position; but the latter, near its insertion, was surrounded by extravasated blood. The coraco-brachialis was uninjured. In a space between the axillary plexus and the coraco-bra-

chialis, the dislocated head of the bone, covered by its smooth articular cartilage, and by a thin layer of cellular membrane, appeared. The capsular ligament was torn on the whole length of the inner side of the glenoid cavity, and would have admitted a much larger body than the head of the os humeri through the opening. The tendon of the subscapularis muscle, which covers the ligament, was also extensively torn. The opening of the ligament, through which the tendon of the long head of the biceps passed, was rendered larger by laceration, but the tendon itself was not torn. The head of the os humeri was thrown on the inferior costa of the scapula, between it and the ribs, and the axis of its new situation was about an inch and a half below that of the glenoid cavity from which it had been thrown."

The second case which Sir Astley Cooper had an opportunity of examining, was one in which the dislocation had existed for five weeks, and Sir Astley believed that the poor woman died from violence used in the unsuccessful efforts to accomplish reduction by extension. Sir Astley says, "The capsular ligament had given way in the axilla between the teres minor and subscapularis muscles; the tendon of the subscapularis was torn through at its insertion into the lesser tubercle of the os humeri, and the head of the bone rested upon the axillary plexus of nerves, and the artery. Having determined these points by dissection, I next endeavoured to reduce the bone, but finding the resistance too great to be overcome by my own efforts, I became very anxious to ascertain its origin. I therefore divided one muscle after another, cutting through the coraco-brachialis, teres major and minor, and infra-spinatus muscles; yet still the opposition to my efforts remained, and with but little apparent change. I then conceived that the deltoid must be the chief cause of my failure, and by elevating the arm I relaxed this muscle, but still could not reduce the dislocation. I next divided the deltoid muscle, and then found the supra-spinatus muscle my great opponent, until I drew the arm directly upwards, when the head of the bone glided into the glenoid cavity. The deltoid and supra-spinatus muscles are those which most powerfully resist reduction in this accident."

Sir Philip Crampton records an examination which he made by dissection, of a recent dislocation downwards in a labouring man, who was brought to the Dublin Infirmary in 1808 in a dying state, owing to injuries received by the fall of a wall. The dislocation was of the right shoulder, and death took place in about two hours. The head of the humerus was lodged on the neck of the scapula and upper part of the inferior costa, and surrounded by cellular tissue extremely ecchymosed. The head of the bone had pressed down the teres minor, and in its descent had passed through the subscapularis muscle, the fibres of which embraced the neck of the bone. The fibres of the subscapularis were also partly torn up from the scapula. The triceps crossed the neck of the humerus on its dorsal side, and the coraco-brachialis and short head of the biceps described a curve on its sternal side. The tendon of the long head of the biceps remained in its groove, but its sheath was partially lacerated. The tendons of the supra and infra-spinati, and of the teres minor, were completely torn off from the humerus, and along with them the surface of the greater tubercle. The

capsular ligament was torn from the lower part of the neck of the humerus to the extent of half its circumference, and the axillary vessels and nerves were made to describe a curve backwards, by the presence of the head of the bone which was in contact with them.

When I taught anatomy in this University, a body, apparently that of a labouring man, was brought to the dissecting-room, which presented all the appearances of a dislocation downwards of the shoulder. I made a careful dissection of all the parts, and the preparation is still in my possession. The dislocation must have been of very long standing, as the glenoid cavity was a good deal filled up, and a new shallow cavity formed on the neck and upper part of the inferior costa of the scapula for the head of the humerus, which had lost its cartilage, and was covered over with porcelaneous deposit. The cellular tissue was thickened about the ball, to form a capsular ligament; and the precise position into which the head of the humerus was pushed, in escaping from its socket through the under part of the capsular ligament, was behind the subscapularis, in front of the teres minor and long head of the triceps, and upon the teres major and latissimus dorsi muscles, with the axillary vessels and nerves to its inferior and inner aspect. As the body was brought to the dissecting-room at the period when subjects were procured by exhumation, I found it impossible to procure a history of the case.

Treatment.— Various methods are employed for accomplishing reduction.

By the Knee in the Axilla.— If the dislocation be recent, and in a thin, attenuated subject, let the patient be seated on a low chair, and let the surgeon, placing himself beside him with his foot resting upon the chair, put his knee into the axilla, and while with one hand he presses upon the acromion, with the other let him

Fig. 62.



Fig. 63.



depress the elbow, thus making his

knee a fulcrum, and the humerus of the patient a lever. I have often reduced dislocations by this method with the greatest ease.

By the Heel in the Axilla.—This is a mode which has been very strongly recommended by Sir Astley Cooper, and is often attended with success. The patient is placed in the recumbent posture on a couch, and the surgeon having applied a wetted roller round the lower part of the arm, and having tied a handkerchief or towel round the arm above the wetted roller, places himself on the same seat with one foot resting on the floor, and the heel of the other in the axilla, and then extends the arm by pulling the towel or handkerchief.

In this method of reduction there are various ways of applying the extending force. One is that just described; another is to apply the handkerchief to the wrist; a third is for the surgeon, having put a skein of worsted round the arm, to pass his head through the double of the worsted, and make it rest on the back of his neck, and while pulling the arm to raise up and draw back his own body, by which means he

Fig. 64.



will be able to exert a much greater extending force than by either of the two former ways; and a fourth plan, which may be adopted in cases of considerable difficulty, is to make the assistants give additional extending force by pulling the ends of the towel or handkerchief fixed round the arm. It has been remarked that a great advantage of this method of reduction is, that the surgeon, both at the long end of the lever and at the fulcrum, has his sense of touch to appreciate the effect produced by the force, and is able, therefore, at once to modify its application as circumstances may require; and as soon as the heel detects the slightest change in the position of the bone, he can immediately direct the humerus towards the glenoid cavity.

By Manual Extension.—The patient being placed in a chair, the first object is, to fix the scapula so as to afford the necessary counter-extension. This may be done by applying the double of a sheet under the axilla, carrying it over the opposite shoulder, and fixing it to some post or resisting object on the opposite side of the patient to that on which the injury is situated. If the sheet be not very much pressed up to the axilla, and its extremities be raised up so as to be on a level with

the opposite shoulder, it will fix only the body and under angle of the scapula, and leave the parts near the glenoid cavity to be drawn from the chest by the extending force applied to the arm. The more elegant method of affording counter-extension is by a well-padded ring of leather, having attached to it two belts, by which it may be fastened to a post or any resisting object; and the trunk and scapula being thus fixed, the necessary counter-extension is obtained. The next object is to employ extension; and, for this purpose, a few turns of a wetted roller should be applied to the arm above the elbow, and a band of worsted, or a piece of linen, fastened upon it by the clove-hitch knot; for this knot, while tight enough to prevent slipping, cannot become so tight as to produce dangerous compression. The arm should be elevated to the horizontal position, to relax the deltoid and supra-spinatus muscles; and extension should be afforded by assistants drawing the ends of the worsted, or towel, or linen, gradually, slowly, and steadily; and after the extension has been kept up for several minutes, and while it is still so, the surgeon, placing his foot upon the chair in which the patient sits, should put his knee into the axilla, and with one hand press the acromion downwards and inwards, and with the other slightly press down the elbow, pushing the head of the bone upwards by means of the knee, which can be done by raising the foot so as to rest it on the toes. During the whole time the surgeon, before the introduction of Chloroform, used to divert the patient's attention by engaging him in conversation; but with such an invaluable auxiliary, that practice is no longer needful.

By means of Pulleys.—If it be probable, from the muscular strength of the patient, or from the time that has elapsed since the occurrence of the dislocation, that very considerable extension will be required, it is advisable to afford it by means of pulleys. Previously to their use, the surgeon will diminish the degree of resistance to be overcome, by bringing the patient fully under the influence of chloroform. The necessary counter-extension can be very conveniently afforded by the plan recommended in the description of the former method of reduction. The extending force may be applied to the lower part of the arm, by placing round it a few turns of a wetted roller, over which a belt of leather is fastened, with two straps extending from it, at the extremity of each of which is a ring, to which the hook at one end of the pulleys is fixed, while the hook attached to the other set of pulleys is affixed to a ring in some resisting object, care being taken that the ring is on a level with the line of counter-extension. Extension is then produced by pulling the cord of the pulleys. This method is useful for allowing the application of considerable extending force, which, however, might be afforded in the ordinary way, by increasing the number of assistants; but the principal advantage of the pulleys is, that by them the force can be applied steadily and gradually; whereas, when extension has to be long kept up by the usual method, the assistants become wearied, and the extension is unequal and accompanied with sudden jerks. The pulleys so greatly increase the force, that few assistants are required. The proper method of applying extension by the pulleys, is to draw the cord slowly and steadily, until the extension becomes considerable, to keep up the same degree of extension for several minutes, and then to increase it again gently. When

considerable extension has been employed, the surgeon should, by placing his knee in the axilla, with one hand on the acromion, and the other on the lower part of the arm, endeavour to replace the head of the bone in the manner described in the last section. In this method the surgeon, although sensible of the return of the bone into its natural situation, seldom finds it return with a snap, as when reduction is accomplished by the other methods.

II. COMPLETE DISLOCATION FORWARDS.

Symptoms.—In this dislocation, there is the absence of the natural roundness of the shoulder, the acromion more pointed, and the vacuity greater than in the former dislocation. There is an unnatural flattening of the shoulder behind, and an unnatural tumour, caused by the head of the bone, below and to the sternal side of the coracoid process, and below the middle of the clavicle. The elbow is removed from the trunk, and drawn a little backwards; and the long axis of the humerus, instead of being parallel with the trunk, and directed upwards to the glenoid cavity, inclines towards the trunk, and extends upwards to a point underneath the middle of the clavicle. The forearm is at a right angle with the arm. The pain is less than in the former dislocation, but the motions of the joint are much more restrained; for any movement of the arm backwards is prevented by the resistance of muscles, movement outwards by the clavicle opposing the head of the bone, and motion forwards by the head of the bone striking the coracoid process.

With regard to another symptom, namely, whether the arm be shortened or lengthened, surgical authorities are divided. According to Sir Astley Cooper, the arm will be somewhat shortened, but he does not, in any of the cases recorded in his work, mention the state of this symptom, although it must no doubt have been from what he observed in those cases that he arrived at the above conclusion. In a very interesting case recorded by Sir Philip Crampton,—a case well worthy of attention, inasmuch as it settles another disputed point, which will presently be mentioned, the axis of the head of the bone was nearly a quarter of an inch higher than that of the glenoid cavity: the arm, therefore, must have been shorter than natural.

On the other hand, Desault and Malgaigne maintained that there would be elongation; and Baron Dupuytren, although at one time of opinion that the arm could be elongated only in dislocation downwards, afterwards agreed with Desault and Malgaigne, and stated, that after dissecting the ligaments in a recent joint, and producing dislocation, he found the arm had lengthened as much as half an inch.

There is a point, concerning which, for a considerable time, there existed much difference of opinion, namely, whether complete dislocation forwards be a primary or consecutive dislocation,—that is, whether the bone can be sent out at once by violence from the glenoid cavity to the situation which it occupies in this dislocation; or whether it be first dislocated downwards, and suffer a secondary displacement upwards, by the muscles drawing it upwards and inwards, as far as the clavicle will allow. Some have gone so far as to say, that the head of the bone can-

not get into the position it occupies in this dislocation, except by suffering a secondary displacement, after having first been forced downwards. Others, for example, Desault, Petit, Dupuytren in France, and the late

Fig. 65.



Mr Hey, and Professor Samuel Cooper in this country, did not deny the possibility of its being primary, but they believed, as will be seen by a perusal of their writings, that it is in fact very seldom primary, and almost always consecutive to dislocation downwards. It is very evident that Sir Astley Cooper considered this a primary dislocation. The case recorded by Sir Philip Crampton, which will be described in mentioning the state of the parts, very clearly proves that, in some cases at least, this dislocation is primary.

State of the Parts.—In the third volume of the “Dublin Journal of Medical Science,” there is a case of undoubted primary dislocation recorded by Sir Philip Crampton, which is interesting, not only as setting at rest the long-disputed question above-mentioned, but also as being the first recorded dissection of the parts in an example of recent dislocation forwards. “The head of the humerus was lodged on the inner side of the neck of the scapula, to the sternal side of the root of the coracoid process, and extending up nearly as far as the notch in the superior costa. The capsular ligament was perfectly entire in the direction of the axilla, showing that the bone could not have been sent first to the axilla and afterwards to the situation here described. The opening in the capsular ligament was on its inner side, and was caused by its being torn from the glenoid cavity, the rent extending from the supraspinatus muscle above to the under part of the subscapularis muscle below.

The supra and infra-spinati were much on the stretch, but not lacerated, and the subscapularis muscle was partly detached from the upper and the anterior parts of the subscapular fossa, and pressed downwards, so that its fibres in a curved manner embraced the neck of the bone. The axis of the head of the bone was scarcely a quarter of an inch above the centre of the glenoid cavity, and the vessels and nerves were on the sternal side of the humerus." Mr. Key made a dissection of a shoulder which had long been dislocated inwards. The glenoid cavity was completely filled up by ligamentous matter, and the head of the humerus was situated under the clavicle to the sternal side of the root of the coracoid process, in contact with the venter of the scapula, from which the subscapularis muscle was at that part torn off, and separated from the ribs by that muscle and the serratus magnus muscle. A new socket and complete capsular ligament had been formed.

Fig. 66.



I believe that in complete dislocation inwards, the head of the bone will generally be in the position described above, with the pectoral muscles before it, and the axillary vessels and nerves to its sternal side.

Treatment.—The reduction is to be effected by the means recommended in describing the methods by manual extension, and by pulleys, in the former dislocation, with the two following peculiarities:—First, that the extension should be made downwards and outwards, in the line of the unnatural direction of the axis of the humerus, until the head of the bone be below the coracoid process; then the extension should be continued with the arm raised to the horizontal position. Second, that after extension has been applied for a considerable time, and while it is still being continued, the surgeon should endeavour to replace the head of the bone, by employing the humerus as a lever, pressing the lower part of it forwards, and its head backwards in the direction of the glenoid cavity; and while doing so, he should also rotate the arm. This can be most effectually done by using the forearm as a lever, having it bent at a right angle with the arm, in order to prevent stretching of the biceps, which would be an obstacle to reduction.

In attempting replacement in this, as in every other dislocation, the extension and counter-extension must always be in a line with each other.

III. PARTIAL DISLOCATION FORWARDS.

Symptoms.—The head of the bone is drawn forward against the coracoid process, where there is an unnatural tumour, whilst there is a depression opposite the back part of the shoulder joint. The posterior half of the glenoid cavity is perceptible to the fingers, whilst the long axis of the humerus is in front and in a line with the coracoid process. The elbow is slightly removed from the side, and is in a line behind the

long axis of the body. The arm can partially perform such movements as do not require its elevation, but it cannot be raised.

State of the Parts.—The head of the bone is on the scapular side of the coracoid process, and rests against it and the edge of the glenoid cavity, where, in an unreduced dislocation, a new cavity has been found formed for its reception. It seems possible for this dislocation to occur without the capsular ligament being torn through; but in dissecting an old dislocation, it was found that the ligament had been ruptured and become attached to the coracoid process. The latissimus dorsi and two teres muscles are put upon the stretch, and the pectoralis major, except some of its inferior fibres, is relaxed. The spinati muscles are slightly on the stretch, and the posterior fibres of the deltoid are extended, while the anterior are relaxed.

Treatment.—Reduction is accomplished in the same manner as in the preceding injury, namely, by counter-extension, extension, and a lever-like motion of the humerus; less force, however, is required.

IV. DISLOCATION BACKWARDS.

Dislocation of the head of the humerus on the dorsum of the scapula is so rare an accident, that Desault had never seen an instance of it; Baron Boyer met with it but once in the living body; only two cases occurred at Guy's Hospital in thirty-eight years; in the same number of years Sir Astley Cooper met with two cases, and not more than four cases occurred in his practice during his whole professional career; and Mr. Lawrence, in his lectures, delivered at St. Bartholomew's Hospital in 1830, states that at that time he had never seen the humerus dislocated backwards. Two cases are reported from the Middlesex Hospital; one from the North London Hospital; Mr. Toulmin of Hackney met with a case; Mr. C. M. Coley of Bridgeworth, with two; I have met with two examples, and there are on record a very few other cases, to the particulars of which I may have occasion to refer.

Causes.—In one of the cases seen by Sir Astley Cooper, the injury was produced by pushing a person violently with the arm elevated. Of the two cases which occurred at Middlesex Hospital, the one was caused by a heavy box from the top of a bedstead falling on the hand of the person while the arm was elevated; the other, in a woman ninety-four years of age, was occasioned by a fall on the front of the shoulder, in consequence of having trodden on some orange peel. Mr. Toulmin's case was in an unusually muscular gentleman, and was caused by a fall from his horse. Of the cases narrated by Mr. Coley of Bridgeworth, one was caused by the man being pulled down by a calf which he was driving, a cord which he held fast in his hand being tied to one of the animal's legs; the other by the person being dashed from his horse against a tree, the shock being received on the front of the shoulder. In a case of this dislocation, of long standing, in which Mr. Key had an opportunity of making a minute examination of the state of the parts after death, the injury was caused by spasmodic contraction of the muscles during an epileptic fit. The exciting causes of the other cases recorded are not mentioned.

Symptoms.—The injury is characterized by the absence of the natural roundness of the shoulder, unnatural prominence of the acro-

mion process, with depression under it; unnatural flatness of the anterior part of the shoulder, together with a stretched appearance of the skin at that part, and an unnatural tumour on the dorsum of the scapula underneath the spine, caused by the head of the humerus, which can be very distinctly felt. As to the precise direction of the long axis of the arm and the position of the elbow, surgeons are at variance. In the cases mentioned by Mr. Coley and Mr. Toulmin, the elbow was forward and close to the side. In one of the cases admitted into Middlesex Hospital, the arm was close to the side, and in a line with the long axis of the body. In the other recorded cases the precise position of the elbow is not stated. In one of the cases which I had an opportunity of seeing, the elbow was directed forwards; in the other, it was merely removed from the side of the body. The long axis of the humerus is of course directed to the dorsum of the scapula, and the position of the arm and elbow, as might be expected, from considering what muscles would thus be put upon the stretch, is for the long axis of the arm to extend downwards and forwards, with the elbow removed from the side, and in a line before the long axis of the body. Some surgical authorities give this direction of the long axis of the arm, and this position of the elbow, as symptoms, without stating whether they do so from reasoning on the unnatural condition of the muscles, or from observation. It is not more difficult to explain an occasional deviation from this attitude in this dislocation, than it is to explain how in some very rare instances the elbow is nearly close to the side in dislocation downwards, although, in by far the greater number of examples, it is removed from the side to diminish the painful tension of the deltoid muscle.

State of the Parts.—The head of the bone lies on the dorsum of the scapula, the capsular ligament is ruptured, the muscles in front of the

Fig. 67.



joint are stretched, and the infraspinatus and teres minor are torn up from the scapula, before the head of the bone can arrive at its unusual situation. In the case in which the injury was caused by spasmodic contraction of the muscles in an epileptic fit, and of which a dissection was made by Mr. Key, the gentleman lived for seven years after the accident, but the dislocation could not be kept reduced, and he never resumed the use of his arm. On inspection after death, it was found by Mr. Key, that the explanation of the impossibility of keeping it reduced, was laceration of the tendon of the subscapularis muscle, and its adhesion to the edge of the glenoid cavity with very imperfect union. The anterior part of the capsular ligament was torn at the insertion

of the subscapularis, and the posterior part was carried back with the

bone, which, instead of resting far back on the dorsum of the scapula, rested on the posterior edge of the articular surface, and on the inferior costa close to the articulation.

Treatment.—In two of the recorded cases of this injury, Sir Astley Cooper accomplished reduction by raising the hand and arm, and turning the hand backwards behind the head. In another instance this method was tried without success, and the bone was replaced by extension of the arm, the scapula being fixed by placing the heel in the axilla. In another, reduction was effected by extension from the wrist in the direction of the displaced bone without the heel in the axilla; and in the remaining cases, with the exception of one which remained unreduced, the bone seems to have been replaced by extension and counter-extension, and in some of them with very little difficulty.

The general principles already mentioned as applicable to reduction of dislocation downwards, in the description of the methods by manual extension and by pulleys, are applicable to this luxation; but the extension should be made forwards and outwards, with the arm raised to a horizontal position; and while the extension and counter-extension are being applied, the surgeon should endeavour to direct the head of the bone upwards and forwards by employing the humerus as a lever, pressing the knee against the upper and back part of the humerus, and drawing the elbow a little backwards.

V. PARTIAL DISLOCATION UPWARDS.

This is an accident so extremely rare, that it is not mentioned by many surgical authorities. The possibility of its occurrence is proved by a case which came under the observation of Mr. John Soden, Jun., of Bath, and also by a preparation, to which reference will be found in another page. An account of the case referred to was drawn up by Mr. Soden, and read before the Royal Medical and Chirurgical Society of London, and published in their Transactions for the year 1841. A description of the case will also be found with an engraving in Sir Astley Cooper's work on "Fractures and Dislocations," edited by Mr. Bransby B. Cooper. The following are some of the particulars. Joseph Cooper died in the Bath United Hospital in November, 1839, in consequence of a compound fracture of the skull, and his death afforded an opportunity of examining an old injury of the right shoulder, caused by receiving the whole weight of his body on his elbow in falling backwards. After the subsidence of the inflammatory symptoms which supervened, a difference was perceived between the two shoulders. When the man stood erect with his arms dependent, the bone appeared to be drawn too much up in the glenoid cavity. The power of abduction was very limited, because the humerus came against the acromion process; and when the arm was moved, on placing the hand on the shoulder, a sensation of crepitus simulating fracture was experienced, which, however, was merely the rubbing of the humerus on the acromion process. The head of the humerus appeared unnaturally prominent in front; the man could move his arm backwards and forwards, but was unable to raise the smallest weight; and any exertion or motion which could excite the action of the biceps, caused severe pain, and could not, therefore, be performed. The capsular ligament was but slightly ruptured,

but the tendon of the biceps was dislocated from its groove, and placed on the lesser tubercle of the humerus,—a position which accounted for the pain experienced where any force was used which called the biceps

Fig. 68.



muscle into action. The head of the humerus was sent upwards, and where it was in contact with the acromion process, ulceration had commenced on the head of the humerus. This case shows how greatly the tendon of the biceps contributes to the strength of the joint, and how useful it is, when in its proper situation, for preventing dislocation upwards.

In the museum of the Medico-Chirurgical Society of Aberdeen, there is a preparation of an unreduced partial dislocation upwards, which, in all respects, very closely agrees with the description and figure of the above case. It was taken from the body of a subject brought to one of the dissecting-rooms in Aberdeen.

DISLOCATION OF THE ELBOW JOINT.

This articulation is formed of three bones, the humerus, the ulna, and the radius. It is furnished with four proper ligaments, the anterior, posterior, external lateral, and internal lateral; and it is liable to six dislocations; of which three include both bones of the forearm, and three are dislocations of single bones.

They are named thus—

- Dislocation of both bones backwards.
- Dislocation of both bones inwards.
- Dislocation of both bones outwards.
- Dislocation of the ulna backwards.
- Dislocation of the radius backwards, and
- Dislocation of the radius forwards.

I. DISLOCATION OF BOTH BONES BACKWARDS.

This is the most frequent of the dislocations at the elbow, and is caused sometimes by a wrench, but more generally by a fall on the hand, when the forearm is not perfectly extended. Under such circumstances the radius and ulna come suddenly to a state of rest, and the humerus by the weight of the body is thrown forwards on them.

Symptoms.—There is an unnatural prominence behind the joint

caused by the extremities of both bones, but more especially of the ulna, and an unnatural hard swelling in front of the elbow produced by the extremity of the humerus. The anterior aspect of the forearm is preternaturally shortened. In some cases, the forearm is at a right angle with the arm, while in others it is midway between extension and semi-flexion. The hand is between pronation and supination, but more inclined to the latter. The motions of flexion and extension, as well as those of pronation and supination, are suspended, or at all events very difficult, limited, and painful; but an unnatural lateral motion can be produced. The accompanying figure from Liston, represents an unreduced dislocation of seven years' standing, in which case the movements of the hand were considerably regained.

Fig. 69.



State of the Parts.—The coronoid process of the ulna occupies the olecranon fossa, the head of the radius is lodged behind the external condyle, and the lower end of the humerus rests on the anterior surface of the radius and ulna. All the four ligaments are ruptured, though some of the fibres of the internal lateral are preserved. The triceps muscle is much relaxed from the approximation of its points of attachment; the brachialis anticus and the biceps are either very much put upon the stretch or lacerated, and the former has been found occasionally to tear away a portion of its osseous attachment to the coronoid process. All the muscles originating from either condyle of the humerus, except the supinator radii brevis, are in a state of relaxation.

Fig. 70.



Figs. 69 and 70. From Liston.

Treatment.—Sir Astley Cooper recommends the surgeon, having seated his patient on a low chair, to place his knee in front of the elbow joint, against the front of the radius and ulna, and after having for some time attempted, by pressing backwards with his knee, to dislodge the coronoid process from the olecranon fossa, then forcibly but slowly to attempt flexion of the forearm, when reduction will be soon accomplished. The object of pressing with the knee is, as already stated, to displace the coronoid process from the olecranon fossa; and the object of the forcible flexion is to bring the bones forward to their natural position. Baron Boyer effected reduction in another manner. In accordance with his mode, an assistant is to take hold of the middle of the humerus, and thus afford the necessary counter-extension, and another assistant to make extension at the wrist, keeping the forearm at a right angle with the arm, while the surgeon grasps the elbow with both hands, having his fingers in front of the humerus, and his thumbs on the olecranon process, against which he directs pressure downwards and forwards. According to Sir Astley Cooper's method, the surgeon endeavours to displace the coronoid process from the olecranon fossa, by pressing the knee against the front of the forearm; in Baron Boyer's, by pressing with the thumbs the olecranon process downwards and forwards. In the former plan the bones are brought forward by flexion of the forearm; in the latter, by an assistant pulling at the wrist.

I have, with great ease and readiness, effected reduction by employing two assistants,—one for fixing the humerus, the other for effecting extension, which can be best done by grasping the middle of the forearm with both hands, and pulling forwards—and while extension and counter-extension are being used, by placing the fingers of one hand in front of the forearm, as near as possible to the elbow, and the other upon the olecranon process, and pulling forcibly with both hands, as if the object were to draw the heads of both bones of the forearm away from the humerus. By this means the coronoid process is very speedily dislodged from the olecranon fossa, and the extension then brings the bones forward to their natural situation. The advantage of affording extension, by grasping with both hands the middle of the forearm, is, that the force thus acts as much on the ulna as on the radius; whereas, if extension be applied at the wrist, the force is in a great measure lost, for the ulna, which offers the chief obstacle to reduction, being small near the wrist, and having little connexion with that articulation, is acted upon only indirectly through the medium of the structures by which it is connected with the radius. According to Mr. Liston, reduction is thus accomplished:—"The arm and forearm are extended, and the limb is brought well behind the trunk, so as to relax the triceps; the surgeon performs extension and counter-extension, pulling the forearm with one hand, whilst he pushes with the other, placed on the scapula. If the force thus employed prove insufficient, as it seldom will in recent cases, the patient may be placed on his face on a couch, and on the limb being brought into the favourable position already noticed, counter-extension may be made by the heel planted against the inferior costa of the scapula, whilst the wrist is pulled with both hands."

II., III. DISLOCATION INWARDS, AND DISLOCATION OUTWARDS.

The radius and ulna may be dislocated laterally, that is, they may be drawn to the one side of the humerus or the other; but these dislocations are extremely rare, and never complete, on account of the great breadth of the articulating surfaces. They are readily detected by the unnatural prominence along the plane of the joint, either internally or externally, according to the nature of the dislocation, and by the inability to flex the forearm; and they are easily reduced by fixing the arm, pulling the forearm, and pressing the bone, either outwards or inwards, as the case may demand.

IV. DISLOCATION OF THE ULNA BACKWARDS.

The distinguishing marks of this dislocation are, the projection of the olecranon process behind the humerus, the hand and forearm being twisted inwards to the ulnar aspect of the forearm, and the impossibility of bending the forearm to more than a right angle. In some instances it has been found impossible to bend it even to that extent, and any attempts to do so have caused excessive pain. In one recorded dissection of this dislocation, the coronoid process was lodged in the olecranon fossa; the coronary, oblique, and part of the interosseous ligaments, were torn; the triceps muscle was much relaxed, and the brachialis muscle stretched under the humerus.

Treatment.—Press the knee against the front of the elbow joint; then with one hand attempt to bend the forearm over the knee, drawing it at the same time forwards, and with the other hand, the olecranon process downwards and forwards. In a case occurring in the practice of Mr. Gosset, in which the coronoid process rested on the internal condyle instead of the olecranon fossa, and the pain on bending the arm was insupportable, owing it was supposed to the pressure of the coronoid process against the ulnar nerve, reduction was accomplished by extension and counter-extension applied by two persons pulling in opposite directions, and by the pressure of the olecranon process downwards and outwards, while the forearm was suddenly flexed.

V. DISLOCATION OF THE RADIUS BACKWARDS.

This must be an extremely rare injury, since Baron Boyer has met with it only twice, and Sir Astley Cooper saw it only once in the dead subject, but never in the living body. Mr. Lawrence has seen the accident, and Mr. Bransby B. Cooper gives a short description of one case complicated with fracture of the ulna, which came under his observation; but the most minute account I have seen of this dislocation is by Professor Lagenbeck, of Göttingen, who met with two examples, the one in a man twenty years of age, and the other in a child of five years. In these cases, which are published in "The Lancet," the hand was prone and could not be brought into a state of supination; the forearm was moderately bent, and admitted of neither flexion nor extension; the skin was lax along the inner side of the internal condyle, and the head of the radius could be felt behind the external condyle; the articulating cavity of the head of the bone could be felt in the child, but its circum-

ference only in the adult. In both these cases, replacement was accomplished by applying counter-extension to the arm, and extension to the forearm, and pressing the head of the bone inwards. Strong and long-continued extension was necessary in the one case, while very moderate extension with pressure was sufficient in the other. In this injury, extension should be made from the hand, and when it has been employed for some time, and is still being continued, it would be judicious, besides pressing the head of the bone inwards, to supinate the hand forcibly, which would assist the pressure in sending the head of the bone forwards, because in supination, while the under extremity is sent outwards, the superior is directed forwards. In the example which Sir Astley Cooper met with in the dead subject, the account of the state of the parts on dissection is as follows:—The head of the radius was found behind the external condyle, the coronary and oblique ligaments were torn, and the capsular ligament—by which I suppose is meant part of the external lateral, and anterior ligaments,—had partly given way.

[Dr. Gibson, of the University of Pennsylvania, states, in the first volume of his *Surgery*, that he has seen several cases of dislocation backwards of the head of the radius, and that he considers it more common than dislocation forwards. In 1826, he exhibited to the class “a case in which both radii were luxated at the same moment, from the patient being precipitated suddenly before a hogshhead of sugar, whilst in the act of rolling it.”—ED.]

VI. DISLOCATION FORWARDS OF THE RADIUS.

Baron Boyer never met with this dislocation, and says, that no authentic example exists of the bone being thrown forwards on the external condyle. Many cases, however, are recorded: Sir Astley Cooper met with six examples; Mr. Bransby B. Cooper with two; and instances have occurred in the experience of Mr. Lawrence, Mr. Tyrrel, Mr. Gosset, and many other surgeons. I have met with two examples, the one in a girl of eleven, the other in a boy of about thirteen years of age: the symptoms were nearly the same in both cases. The forearm was about midway between complete extension and semiflexion, the hand slightly supinated, making an angle of about forty-five degrees with the plane of complete supination; the movements in the direction of pronation and supination, as well as those of flexion and extension, were extremely limited; and on attempting to bend the forearm, I was particularly sensible of a sudden check to further flexion by an obstacle which left a decided impression of its being caused by one bone striking against another. There was a perceptible alteration of the direction of the long axis of the radius, which, instead of leading up to the under part of the external condyle, was directed in front of it, where the head of the radius could be distinctly felt, forming an unnatural tumour. There was an unnatural depression perceptible below the external condyle, and in one of the cases the patient complained of great pain in the upper part of the interosseous space, which pain was much aggravated by pressure. In each case, I accomplished reduction by making one assistant fix the humerus, and another effect extension from the hand, by which means the force acts on the radius alone; and when extension

and counter-extension had been employed for some time, and were still being used, with the arm as straight as could be made, I then with the thumb of one hand forcibly pressed the head of the bone backwards, making at the same time with the other hand, a forcible attempt at pronation, when the head of the bone was tilted back into its proper situa-

Fig. 71.

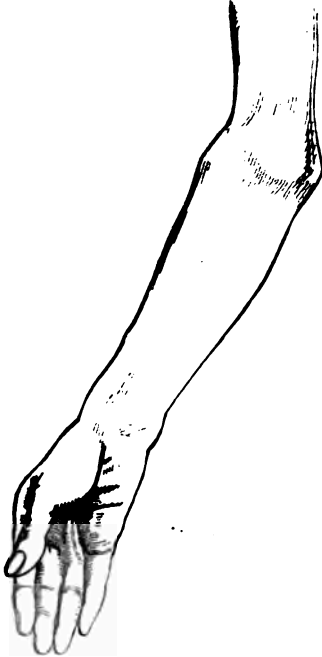


Fig. 72.



tion. In one of the cases, reduction was accomplished with great difficulty, in consequence of its having remained for four days unreduced, during which the case was treated as a sprain by a practitioner, who mistook the nature of the injury.

The head of the bone rests above the external condyle, and it is the resistance offered by the humerus which prevents flexion of the forearm. The external lateral, and anterior ligaments of the elbow-joint are lacerated, as are also the coronary, the oblique, and part of the interosseous; otherwise the radius could not get into its unnatural situation.

The two dislocations last described are as properly accounted dislocations of the superior radio-ulnar articulation, as of the elbow-joint,—both articulations being involved in the injuries.

DISLOCATIONS OF THE INFERIOR RADIO-ULNAR ARTICULATION.

These injuries, which consist of the displacement of the one bone with respect to the other at the inferior radio-ulnar articulation, are

Fig. 72. From Liston.

not to be confounded with dislocations of the wrist-joint. The writers, who have described these rare accidents, have not all employed the same nomenclature, some making the direction of the radius, others that of the ulna, the basis of arrangement. There are only two of these dislocations. They are described by some authors as dislocation forwards and dislocation backwards of the radius; by others, as dislocation backwards and dislocation forwards of the ulna. As the two bones are driven in opposite directions, it follows, that the dislocation forwards of the radius of some authors is the dislocation backwards of the ulna of others, and that dislocation backwards of the radius of some is the dislocation forwards of the radius of others. In the following description the direction of the radius is made the basis of arrangement.

These dislocations are generally produced by the hand being carried too far round in the directions of pronation and supination; and of the two, dislocation forwards is the more frequent, partly, because the motion of pronation is more extensive than that of supination, and partly, because violent and immoderate force, which is often required in efforts accompanied with pronation, can seldom be necessary in any offices which the hand has to perform in a state of supination. Desault records the case of a laundress who, by a violent pronation of her hand in wringing a wet sheet, produced dislocation forwards of the radius. The dislocation backwards of the radius has not in every case been caused by supination. Dupuytren mentions the occurrence of an example in one of the gendarmerie, where the injury was occasioned by his horse falling, and his forearm being crushed between the horse's head and the ground. The dislocation forwards seldom occurs; and the dislocation backwards is so extremely rare, that in a long experience Desault never met with it in the living body, and only once in the dead subject; Dupuytren saw but two cases, Boyer but one; and Sir Astley Cooper has not recorded a single example.

In dislocation forwards the forearm is bent, the hand being carried beyond the natural extent of pronation; there is an unnatural prominence at the posterior and inner part of the wrist, caused by the ulna; and the motions of pronation and supination are suspended. Replacement is easily accomplished in the following manner:—The arm is fixed by an assistant, and the surgeon, with the fingers and thumb of one hand, separates the bones from each other, pressing the one backwards and the other forwards, and with the other hand, he at the same time forcibly turns the hand into a state of supination; by which movement the radius is sent back to its proper position. The injury is caused by violent pronation: it is reduced by forcible supination.

In dislocation backwards the hand is carried beyond the natural extent of supination; the motions of pronation and supination are suspended; the natural prominence formed by the ulna at the back of the wrist disappears; and an unnatural projection in front of the wrist is caused by the under part of the ulna. In the example of the officer, whose case is recorded by Dupuytren, and where violent supination was not the cause of the injury, the hand was not supinated, but midway between pronation and supination. The direction of the ulna was too far forward, the lower extremity coming in front of the radius; there

was an unnatural depression at the back, and an unusual prominence in front of the wrist. Replacement may be accomplished by fixing the arm, and with one hand separating the bones from each other, pressing the one backwards and the other forwards, and with the other hand forcibly producing pronation; by which means the hand, and with it the radius, is carried forward. The dislocation may be caused by supination being carried to too great an extent, and it may be reduced by forcible pronation.

Violent pronation may cause dislocation backward of the upper, and forward of the under extremity of the radius; and forcible supination is a principal means of reducing these dislocations.

Supination carried beyond the proper extent may induce dislocation forward of the upper, and backward of the under extremity of the radius; and forcible pronation is of the greatest consequence in reducing these dislocations.

DISLOCATION OF THE RADIO-CARPAL ARTICULATION, OR WRIST-JOINT.

This articulation is formed above, by the radius and triangular fibrocartilage, and below, by the first three bones of the carpus, namely, the scaphoid, semilunar, and cuneiform bones. It is furnished with four ligaments, and is liable to five dislocations. Both bones of the forearm may be thrown forwards, backwards, inwards, or outwards, and the radius alone may be driven forwards on the front of the carpus. The dislocations forwards and backwards are exceedingly rare, especially the former. The celebrated Dupuytren went even so far as to say, "that there was not a single unequivocal instance on record of a dislocation of the radio-carpal articulation, and that he invariably found these pretended accidents always turned out to be fractures of the radius near the articulation." It is now, however, quite certain that these dislocations, though rare, do occasionally take place.

I. DISLOCATION FORWARDS.

The dislocation forwards is produced by a fall on the palm of the hand during extension, and may be detected by a swelling on the fore part of the wrist, produced by the radius and ulna, and another on the back part, caused by the carpus; by an unnatural depression above the last-mentioned swelling; by the styloid processes of the radius and ulna not presenting their natural relation to the carpus, and by the hand being extended and fixed.

II. DISLOCATION BACKWARDS.

The dislocation backwards usually occurs from a fall on the back of the hand, while the hand is fixed. It is characterized by two unnatural swellings,—one on the back of the wrist, caused by the radius and ulna, the other in front, caused by the carpus; and by the hand being violently bent and fixed.

These dislocations may be distinguished from sprains by the existence of two swellings; whereas in sprains there is only one; and that does not appear immediately, but, when it does, gradually increases. For distinguishing between dislocation of the wrist, and fracture of the radius

near the wrist, when the inflammatory swelling renders it difficult to detect the real nature of the case, it is of importance to take hold of the hand, and move it, observing at the same time whether or not the styloid processes of the radius and ulna be movable. If the injury be a fracture, they will change their position; but if it be a dislocation, they will remain fixed.

III., IV. LATERAL DISLOCATIONS.

The lateral dislocations are never complete, on account of the breadth of the articulating surfaces; in consequence of which some part of the under portion of the articulation still rests against some part of the upper. A projection of the carpus on the one side of the wrist, and of the radius or ulna on the other, with a fixed condition of the hand, are symptoms sufficiently diagnostic to make these injuries easy of detection. The deformity of parts is so distinct, that there can be no difficulty in recognising these accidents, and their replacement is equally easy by the following means.

While the forearm is held firmly by an assistant, so as to afford the necessary counter-extension, and another assistant makes extension from the hand, the surgeon should press the displaced bones towards their proper situation. When extension and counter-extension have been used to a sufficient degree to prevent the bones from pressing against each other, the contraction of the muscles will powerfully aid in accomplishing reduction. After reduction, antiphlogistic remedies, of rather a smart character, are frequently necessary to subdue the very considerable tumefaction and inflammation which sometimes result from the injury to the soft parts; and recourse must be had to the cautious use of a splint, to prevent any motion of the hand which would be apt to cause a recurrence of the dislocation, and hinder the union of the ligaments; but care must be taken so to apply it, as not to produce any pressure, which would aggravate the local inflammation, if it should supervene.

V. DISLOCATION FORWARDS OF THE RADIUS ALONE, ON THE FORE PART OF THE CARPUS.

This is quite a different dislocation from that of the radius forwards at the inferior radio-ulnar articulation. In this dislocation the styloid process is no longer in a line with the radial side of the carpus; the under extremity of the radius forms a protuberance on the front of the carpus; the hand is fixed, and its outer border is twisted backwards, and its inner forwards. These symptoms are sufficiently diagnostic of the nature of this injury, the reduction and after-treatment of which are the same as when both bones are displaced.

DISLOCATIONS OF THE THUMB.

The first metacarpal bone of some anatomists, the first phalanx of the thumb of others, is capable of being dislocated in four directions, namely, inwards, outwards, forwards, or backwards; but, in general, it is dislocated only forwards or backwards. Mr. Lawrence is of opinion that a dislocation backwards is the only dislocation of this bone that can take place. In many cases seen by Sir A. Cooper, the metacarpal bone was thrown inwards, between the os trapezium and the

metacarpal bone of the fore-finger, so as to form a protuberance towards the palm of the hand. The thumb was bent backwards and did not admit of being brought towards the little finger. The unnatural protuberance, formed by the articular end of the bone, is so very conspicuous, that the nature of the accident is immediately recognised. Much pain and swelling are produced by the accident. For facilitating reduction, Sir A. Cooper advises extension to be made with the thumb inclined towards the palm, in order to relax and diminish the resistance offered by the flexor muscles. After steady extension for a considerable time, the bone should be forced into its place by making pressure with the fingers on the head of the bone. When reduction is impracticable, Sir Astley deems it preferable to leave the case to the degree of recovery which nature will in time produce, rather than run any risk of injuring the nerves and blood-vessels by dividing the muscles or ligaments.

Dislocation of the first Phalanx.—A more frequent, and at the same time more troublesome dislocation, because of the difficulty of its reduction, is the dislocation of the first phalanx from the metacarpal bone. The deformity of the parts reveals the nature of the injury. The extremity of the first phalanx forms a prominence on the back of the head of the metacarpal bone, and the lower part of the metacarpal bone is equally perceptible on the palmar side. In reducing it, which it is comparatively easy to accomplish in the recent state, the thumb should be inclined towards the palm; and during straight extension of the thumb, pressure should be made with the finger on the head of the extremity of the first phalanx. But after a little time has elapsed, there is often very great difficulty in effecting reduction,—so much so, that Sir A. Cooper considered dislocations of the thumb as the most difficult to reduce. “In order to relax the parts as much as possible, the hand should be soaked for a considerable time in warm water; a piece of wetted wash-leather is to be as closely wrapped round the first phalanx as possible; a tape, about two yards in length, should be fastened on the leather with a knot that will not slip, such as the sailors call the clove-hitch. An assistant should now firmly press on the metacarpal bone, by putting his middle and first fingers between the fore-finger and thumb of the patient, and thus make a counter-extension, whilst the surgeon, assisted by others, draws the first phalanx from the metacarpal bone, inclining it at the same time a little towards the palm of the hand. If the efforts made in this way, after having been continued ten or fifteen minutes, should not succeed, then it will be necessary to adopt another plan, which is this,—in addition to the apparatus already employed, let a strong worsted tape be carried between the metacarpal bone and fore-finger, bend the forearm round a bed post, and let the tape be firmly tied to it, so as to prevent the

Fig. 73.



hand yielding when extension is made. To the tape surrounding the first phalanx a pulley is to be applied, and extension made, which will generally succeed."—Sir A. Cooper, Lectures on Surgery, pp. 688, 689.

The proposal has been suggested of dividing one of the lateral ligaments with a couching needle, or a very small knife, when reduction is impossible by ordinary means. The best authorities, in general, unite in condemning this practice on account of the frequency with which tetanus is induced by injuries of tendons and ligaments connected with the thumb. Mr. Syme, however, says:—"In cases where the difficulty proves insuperable, one of the lateral ligaments may be cut, which would certainly be better than leaving the bone unreduced, as has sometimes been the case."

Sometimes the dislocation takes place in the other direction, the metacarpal bone being forced behind the extremity of the first phalanx. Here there is less difficulty in accomplishing reduction.

The phalanges of the fingers are sometimes dislocated backwards. The accident cannot be mistaken, and reduction by means of extension is accomplished with facility.

DISLOCATIONS OF THE HIP JOINT.

The ilio-femoral articulation, or hip joint, is formed by the cotyloid cavity of the os innominatum, and the head of the femur. It is furnished with a large synovial membrane, and five ligaments, namely, the capsular, the accessory, the cotyloid, the transverse, and the ligamentum teres or round ligament. The direction in which the ball of the femur is sent from the acetabulum is the basis of arrangement of its different dislocations.

It will facilitate the description of the various dislocations of the hip joint to arrange them in two grand classes, *the regular*, and *the anomalous*. Of the former class there are four different kinds, and the same number of the latter class have been recorded.

REGULAR DISLOCATIONS OF THE HIP JOINT.

The head of the thigh bone may be thrown from the acetabulum in the four following directions, constituting the four regular dislocations:—

1. Upwards, upon the dorsum of the ilium.
2. Backwards, into the ischiatic notch.
3. Downwards and forwards, into the foramen ovale.
4. Forwards, upon the pubes.

With regard to the proportionate frequency of these several dislocations, Sir Astley Cooper says, that in twenty cases, you may have twelve of the first kind, five of the second, two of the third, and one of the fourth.

I. DISLOCATION UPWARDS ON THE DORSUM OF THE ILIUM.

Symptoms.—When the bone has been displaced in this direction, the dislocated limb is more or less shortened. This symptom appears im-

mediately, but, after the muscles have had time to contract, it increases so much, that the point of the great toe of the affected side does not extend beyond the tarsus of the other foot. The shortening will be best seen by supporting the patient in the erect posture, and comparing the position of the toes, or of the inner ankles. The thigh, leg, and foot are all inverted, so that the great toe of the dislocated extremity rests on the tarsus of the opposite foot. The knee is very slightly bent, and a little in advance of the under part of the other thigh. The limb is perfectly immovable to the voluntary efforts of the patient, nor can it be moved by the surgeon in the direction of abduction or of extension; and if it can be slightly moved in the direction of adduction or of flexion, such movements are attended with great pain. There is an unnatural swelling of the hip, caused by the upper part of the femur, and the bulging out of the glutei muscles. If the patient be thin, and the bone be not concealed by extravasation of blood and the general tumefaction of the hip, which may soon follow such an injury, the head of the femur may be distinguished on the os innominatum, with its ball directed backwards, and its trochanter major forwards, and much nearer than natural

Fig. 74.



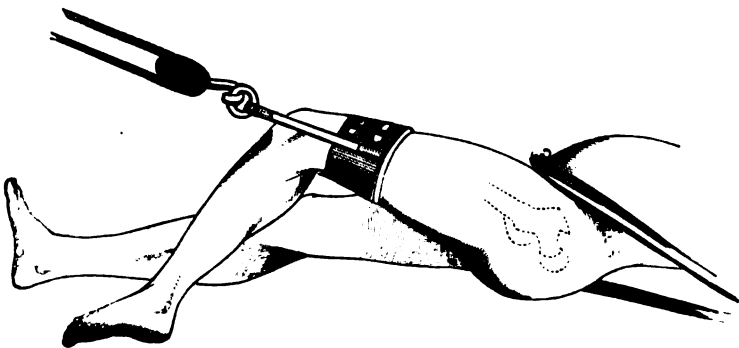
to the anterior superior spinous process of the ilium. Another symptom is, the absence of the natural projection of the trochanter major. The distinctive marks of this injury are so unequivocal that an attentive observer can be at no loss to recognise it. They may be stated briefly to be,—Shortening of the extremity; inversion; the knee slightly bent, and a little in advance; the limb immovable to the voluntary efforts of the patient, and to the surgeon in the direction of extension or abduction; absence of the natural projection of the trochanter; an unnatural swelling of the hip; and the trochanter major raised upwards and forwards, so as to be too near to the anterior superior spinous process of the ilium.

State of the Parts.—The capsular, accessory, and round ligaments must be ruptured, and the muscles torn up from the dorsum ilii, before the bone can occupy its unnatural situation. The upper extremity of the femur rests on the dorsum ilii, the ball being directed backwards, and the trochanter forwards. It has often been a subject of inquiry, why the ball is always directed backwards, and the trochanter forwards, and why it is not thrown into the attitude in which the principal muscles

of the limb would place it. In France, the explanation proposed by Baron Boyer is considered satisfactory. He ascribes it to the strong anterior portion of capsular ligament, which proceeds from the upper and anterior part of the acetabulum to the anterior intertrochanteric line. When the bone is driven upwards, these fibres draw the trochanter towards the acetabulum, and prevent the bone from being twisted outwards as the rotators would direct it.

Treatment.—It is not advisable to attempt reduction, without having previously weakened the muscular power. The means formerly employed for that purpose consisted of copious bleeding, followed by a dose of antimony, or small doses of half a grain every ten minutes until nausea was produced. Or, when it could conveniently be done, the patient was first bled, then placed in a warm bath, and afterwards got doses of antimony until nausea came on, when the muscles were less able to resist reduction. The patient was, in all probability, much less injured by these debilitating remedies, than by the much greater extension which would otherwise have been necessary. Instead of any of the above-mentioned proceedings, the auxiliary now employed is chloroform, which not only has the advantage of being more powerful, but also of preventing pain, and has, besides, no permanently weakening effect on the system. An assistant being in readiness with a set of pulleys, the patient should be placed on his back or opposite side on a table of convenient height, particular care being taken that he be in such a position as to have the long axis of the thigh-bone in a straight line between two rings or staples fixed in some resisting objects in opposite sides of the room. To afford the necessary counter-extension to the pelvis, a strong well-padded leather belt or girth should be passed round the limb, so as to press on the side of the perineum (to prevent the chafing of which the padding is necessary), having its extremities directed outwards and upwards, so as to be in a line with the long axis of the thigh-

Fig. 75.



bone, and fixed to one of the staples or rings before-mentioned. For affording the necessary extension, a few turns of a wetted linen roller should be tightly applied to the thigh, above the knee, over which should be very firmly buckled a leather belt furnished with two straps at right angles to itself, each having a ring at its extremity. The one set of pulleys should be fixed to the rings, and the thigh being

directed a little forwards across the under third of the opposite thigh, and the leg of the affected side bent nearly to a right angle, the other set of pulleys should be fixed to the other ring or staple in the room. The direction of the axis of the thigh being carefully preserved in a straight line with the extending and counter-extending forces, the extension is to be applied by the surgeon himself, or by an assistant under his direction, by drawing the cord of the pulleys. The manner of doing this is, however, of the greatest importance; it ought not to be done suddenly, or violently, but slowly, steadily, and gradually; the cord should be drawn until considerable extension be produced, when the force should not be increased; but steadily kept up; and when the muscles have had time to stretch, it should then be increased; and after another interval, during which the same degree of extension is preserved, the force should be again increased. When the ball of the femur is brought near to the acetabulum, it will be necessary for the surgeon to employ an assistant to keep up the extension; while he himself, taking hold of the femur, endeavours with one hand to raise the head of the bone from the ilium, by pressing upwards with the hand placed under the thigh,—the object being to diminish the resistance offered by the margin of the acetabulum to the ball of the bone gliding over it; and with the other hand he endeavours to rotate the thigh outwards for the purpose of inclining the trochanter backwards and the ball of the bone downwards and forwards. The advantage of attempting rotation must be evident from what has been stated regarding the position of the bone in this dislocation. The bone seldom returns with a snap when the pulleys are employed, from the muscles being so much worn out that they are not able to exert that sudden and powerful contraction which commonly accompanies reduction of a dislocation. The surgeon must, therefore, determine by the absence of the symptoms of dislocation that the reduction has been accomplished.

Fig. 76.



The above are the best appliances for the application of the extending and counter-extending forces: but if they cannot be obtained, a sheet

or tablecloth, with a quantity of tow or linen placed so as to diminish the danger of chafing, may be used for the latter purpose, and a skein of worsted, to which the pulleys may be fixed, for the former.

[The extension may be effected in a very simple manner, by the contrivance of Dr. Gilbert, already described in the first part of the chapter on Dislocation. As will be seen in the wood-cut (Fig. 76), the patient is placed as is usual, and the counter-extension is made in the ordinary way: but the extension is made by twisting by means of a strong stick, a rope which had been twice doubled, and the extremities of which had been properly secured to the limb and to a staple.—ED.]

II. DISLOCATION BACKWARDS INTO THE ISCHIATIC NOTCH.

Symptoms.—In this, as in the last dislocation, we have shortening, inversion, an advanced position of the knee, and a fixed condition of

Fig. 77.



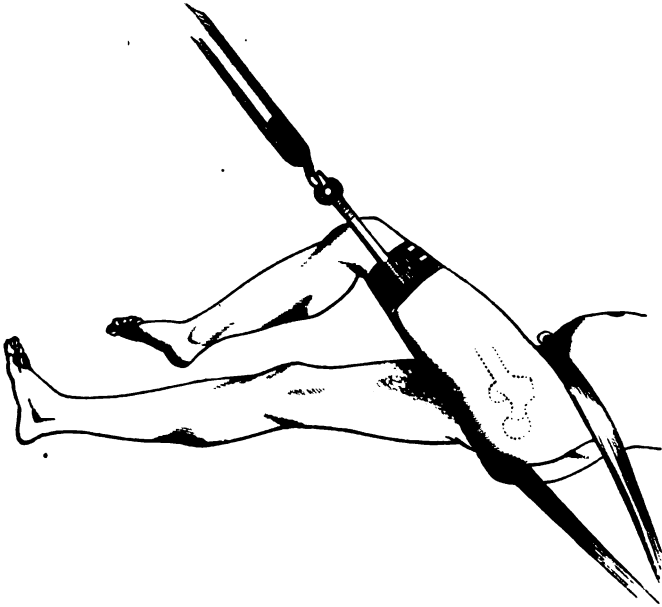
the limb; but the three first mentioned symptoms are to a less extent than in the former case. The shortening and inversion are such, that the point of the great toe rests upon the ball of the great toe of the opposite foot, instead of upon the tarsus. The knee is less advanced, and is slightly bent: and when the patient is placed in the erect attitude, the toes only touch the ground.—There is an unnatural projection on the back part of the hip; the trochanter major is too far forward; and the natural projection formed by it is lost.

State of the Parts.—

The capsular, accessory, and round ligaments are ruptured, and the head of the femur rests on the pyriformis muscle, above the sacro-sciatic ligaments and at the edge of the notch, with its ball directed backwards and the trochanter forwards.

Treatment.—Reduction is exceedingly difficult, but it is to be effected in the same manner, as in the former dislocation, with the following peculiarities, which require careful attention. The direction of the ex-

Fig. 78.



tending force should be across the middle, instead of across the under third, of the opposite thigh; and as the extending and counter-extending forces must always be in a line with each other, the direction of the mechanism for fixing the pelvis, although upwards and backwards, should be more directed backwards than in the reduction of the former injury. The sciatic notch, where the ball of the bone rests, is posterior to the acetabulum, and from the oblique position of the pelvis in the human body, a little higher up; and as the object of extension is to draw the ball forwards and a little downwards, the reason of the peculiarity in the direction of the traction must be obvious. While extension is being made, which ought to be done with the patient placed on his opposite side, the ball of the thigh bone should be raised out of the ischiatic notch, and over the edge of the acetabulum. With this view some recommend that a round towel be placed under the upper part of the thigh and over the shoulders of an assistant, who at the same time resting both his hands on the patient's pelvis, obtains a great power over the dislocated bone.

As a symptom, the knee is less advanced than in the former dislocation; but in reduction, it requires to be raised further forward, and crossed over the other thigh, higher up than is necessary, or proper, in replacing the bone in dislocation upwards.

III. DISLOCATION DOWNWARDS AND FORWARDS INTO THE FORAMEN OVALE.

This dislocation has been known to occur in consequence of a fall from a horse, with the thigh under the body of the animal. It has also been sometimes occasioned by the fall of a heavy weight on the thigh, while the limbs were separated. I once saw an instance of this dislocation caused by the person jumping in great haste out of bed, and while the left foot reached the floor, the right was entangled by the blankets in bed, and in consequence, the ball of the femur was driven against the anterior and under aspect of the joint, thus occasioning a dislocation downwards and inwards.

Symptoms.—The limb is elongated and violently abducted, nor can it without great pain and difficulty be brought near to the other limb.

Fig. 79.



If the patient be raised to the erect attitude, he leans to the affected side; or, if the trunk be kept perfectly erect, the knee is very much in advance; the rationale of which is, that the *psoas magnus*, and *iliacus internus*, are put very much on the stretch, and the patient endeavours to diminish the painful tension, by inclining the trunk to the affected side, or, if that be prevented, by bringing the thigh forward. The toes usually are neither inverted nor everted; the *trochanter major* is less prominent than usual, and there is an unnatural hollow below *Poupart's* ligament.

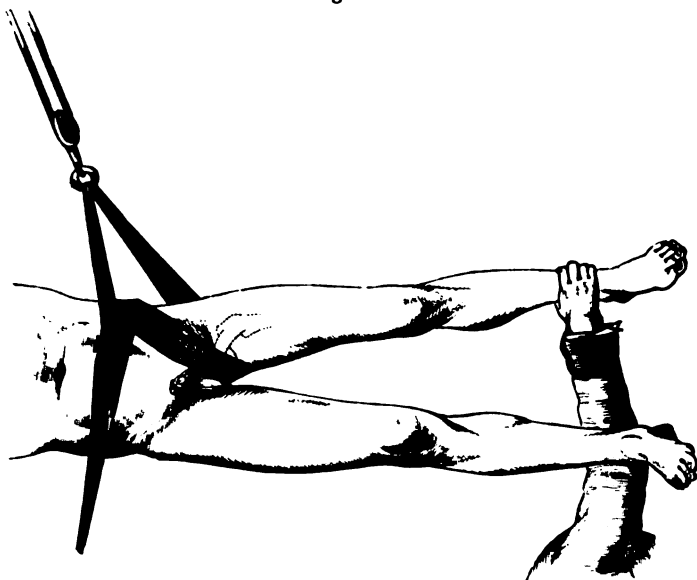
State of the Parts.—The ball of the femur is in front of the *foramen ovale*, resting on the *obturator externus* muscle; and it is important to observe that the ball is directed inwards, and the *trochanter major* outwards. There is rupture of two of the five ligaments of the hip joint, namely, the capsular, and the round. On this last point, however,—the rupture of the round ligament, a difference of opinion exists. Sir *Astley Cooper* believed that in every instance it must be ruptured, and records a dissection of a dislocation in which he found it so, whereas the

celebrated *Delpech*, although he admits that it is sometimes ruptured, asserts that this is not always the case, and relates some cases in which he found it unbroken. Some found their opinion, that the *ligamentum*

teres is not necessarily ruptured, on the fact, that in the dead body, the ball can be placed on the front of the foramen ovale, without rupture of the ligament. I have often in the dead body, after removing all the muscles, and cutting the capsular ligament, placed the ball of the femur in this situation; but it can only be done with the trochanter directed inwards and the ball outwards, in short, by turning backwards the part of the femur which is naturally directed forwards, and leaving the part of the ball to which the round ligament is attached, very near to the margin of the acetabulum. This, however, is not the position of the femur in the dislocation; on the contrary, the ball is directed downwards and inwards, and it will be found impossible in the dead subject, to place it in that position without first cutting through the round ligament. As has already been stated, Sir Astley Cooper is of opinion, that the round ligament is always ruptured; and that the accident cannot occur to a living person, except when the limb is in a state of abduction, in which position the ligamentum teres is upon the stretch, and therefore if the force applied go so far as to dislocate the joint, the ligamentum teres must first give way.

Treatment.—The ball of the femur is too low down, and too near the mesial plane. It may be reduced in one or other of the four following ways.

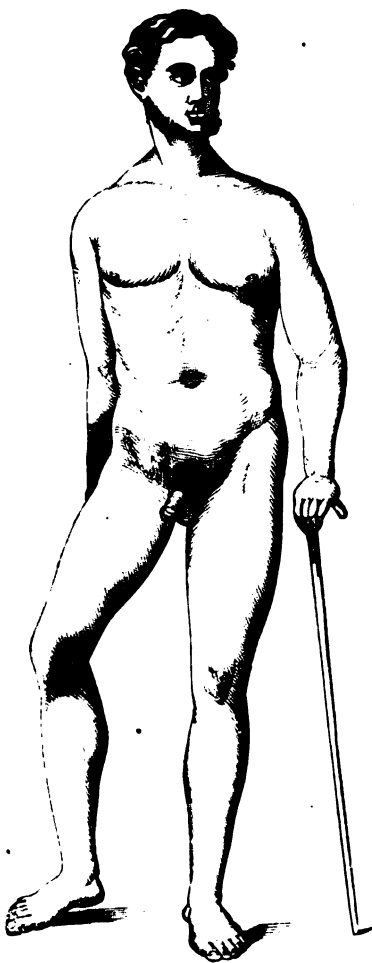
Fig. 80.



1st. The patient is laid on a table on his uninjured side. The pelvis is fixed by a belt placed round it, and secured to the table. Extension is made by another belt placed under the thigh, the edge of which touches the perineum, and pulleys are attached directly above the patient. It is necessary for the surgeon to press down the ankle of the affected side.

2d. Place the patient on his back. Counter-extension is made by a belt or girth, placed round the pelvis, the concavity of the belt being in contact with the injured side, and secured to a staple or some resisting object. The extending force is directed upwards and outwards. After extension has been continued for some time, the surgeon should pass his hand behind the ankle of the sound limb, and grasping the other ankle, should draw it inwards, towards or beyond the mesial plane of the patient's body. While this is being done, the belt in the perineum acts as a fulcrum, the femur as a lever, and the hand as the power;

Fig. 81.



and by bringing the under part of the femur inwards, and a little backwards, the ball is sent upwards and outwards. This is Sir Astley Cooper's method. (See Fig. 80.)

3d. Mr. Hey, of Leeds, reduced this dislocation in the following manner. He desired the patient to sit upon the front of the bed, astride of the bed-post, and to grasp it; he then fixed two towels to the injured limb, and two assistants made extension. While the extension was continued, he crossed the injured thigh over the sound one, and at the same time rotated the limb.

4th. Mr. Hey, in another case, flexed the thigh to such an extent as to form an acute angle with the trunk, and then by a rotatory motion of the thigh effected reduction.

IV. DISLOCATION FORWARDS UPON THE PUBES.

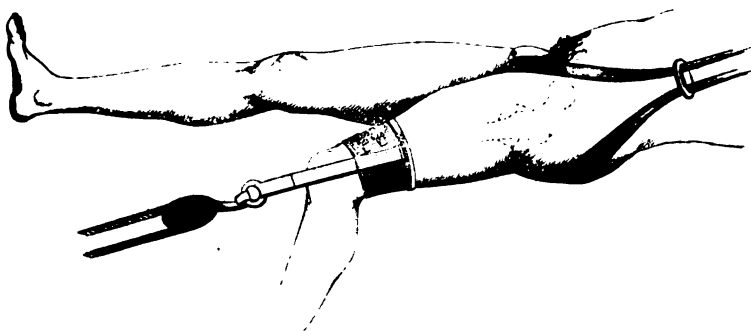
Symptoms.—The limb is shortened, usually to the extent of an inch. The knee and foot are turned outwards, and the knee is drawn forwards and away from the other. The limb cannot be moved at all by the voluntary efforts of the patient, and but very slightly by the surgeon; nor can it be rotated inwards, although it may be pressed a little forwards and backwards. The head of the thigh-bone may be distinctly felt in the groin, giving rise to an unusual protuberance. The round-

ness of the hip is lost in consequence of the trochanter major being drawn too near the mesial line, and the space between the trochanter

major and the anterior superior spinous process is diminished. There is frequently numbness or pain, from pressure on the anterior crural nerve. From these symptoms, compared with what has been stated as to the symptoms in fracture of the neck of the thighbone, the diagnosis may be easily made out.

State of the Parts.—The ball of the femur rests on the anterior part of the pubes, with the trochanter directed backwards. The ball is on the horizontal part of the pubes, superior to the obturator foramen. In some cases it is sent up so high as to be hooked into the pelvis. The capsular and round ligaments must be ruptured, and the accessory may be injured. In a dissection mentioned by Sir Astley Cooper, the head and neck of the femur were driven under the psoas magnus and iliacus internus muscles, which, together with the anterior crural nerve, were thus put much upon the stretch on their way downwards. In a practical point of view, it is of great importance to remember that the trochanter

Fig. 32.



is directed backwards, and the ball forwards,—this being the very reverse of the position of these parts in the dislocations upwards and backwards.

Treatment.—The knee should be pressed a little downwards. The counter-extension should be made over the trunk of the patient, and the extension in a line with it, so as to draw the thigh downwards and backwards. While extension and counter-extension are being employed a towel should be placed under the upper part of the thigh, and an assistant should lift up the head of the bone over the pubes and the edge of the acetabulum, the surgeon at the same time endeavouring to send the ball backwards by effecting rotation inwards of the thigh.

ANOMALOUS DISLOCATIONS OF THE HIP JOINT.

The following anomalous dislocations are recorded:—

1. Dislocation upwards, with the ball below the anterior superior spinous process of the ilium, the neck against the ridge between the anterior superior and anterior inferior spinous processes, and the trochanter directed backwards. An instance of this dislocation occurred

in the experience of Mr. Gibson of New Lanark, and was successfully treated by him and Dr. Cummins.

The symptoms were the following:—the limb was shortened fully three inches, and so fixed that it could not be lengthened in any degree; the limb and toes were everted, rotation inwards was impossible, and any attempt to effect it caused great pain; adduction and abduction were exceedingly painful and difficult, but very limited flexion could be performed with less pain. There was a tumour under the anterior superior spinous process, obedient to the motions communicated to the thigh, the trochanter major could not be felt, and the hip was flattened. The position of the bone was believed to be that which is here described; and, for the accomplishment of reduction, nausea was induced by means of tartar emetic; and then, while counter-extension and extension were being made by means of pulleys, Mr. Gibson raised the thigh-bone, by means of a round towel placed under the thigh and over his own shoulders, at the same time pressing the knee towards the opposite thigh, and forcibly rotating it inward.

2. Dislocation upwards, with the ball between the anterior inferior spinous process and the junction of the ilium and pubes, the trochanter being directed backwards.

A case of this dislocation is recorded by Mr. Morgan in Guy's Hospital Reports. The following were the symptoms:—shortening of the limb to the extent of two inches, extreme eversion of the foot, and a tendency on the part of the injured limb, when left to itself, to cross the sound one, the heel of the former resting on the instep of the latter. The ball of the bone could be discovered under Poupart's ligament; the trochanter could not be felt; and the limb could be moved to a certain extent in any direction except rotation.

The bone was believed to be in the position above described. Mr. Morgan accomplished reduction by counter-extension and extension without pulleys, employing at the same time forcible rotation inwards of the limb. In order to obtain a greater power in effecting rotation, Mr. Morgan bent the leg at a right angle to the thigh, and rotated the thigh by holding the knee with one hand, and the foot with the other.

3. Dislocation downwards on the tuberosity of the ischium with eversion of the foot.

Mr. Keate was called to attend a gentleman who had suffered this dislocation by his horse falling backwards upon him into a narrow ditch, in which position he remained for some time, with his heels directed upwards and the horse's back next to his thigh.

The limb was elongated more than three inches; the leg was bent on the thigh, and the thigh bent on the pelvis; the thigh was carried very far away from the other, the knee and foot were much everted, and the trochanter exceedingly depressed. The ball of the bone was on a level with the tuberosity of the ischium, and it was believed that it had been brought into this situation by the struggling to get released from under the animal, after it had first been dislocated in front of the foramen ovale. In short, it was supposed that it had been first sent in front of the foramen ovale, and afterwards from thence to the tuberosity of the

ischium ; and, therefore, in accomplishing reduction it was first brought from the tuberosity of the ischium to the front of the foramen ovale, and afterwards from thence to the acetabulum.

4. Dislocation of the ball on the tuberosity of the ischium, with shortening of the limb, and violent inversion of the foot.

A maniac became the subject of this dislocation, in consequence of leaping from a window in a third story. In falling, his thigh struck against the railing, and was violently driven upwards. He died in about an hour, and as he was evidently sinking from other injuries, the dislocation was not reduced. The limb was shortened and inverted ; the thigh was bent and immovable, crossing the pubes obliquely to the opposite side. On dissection, the head of the femur was found to be above the quadratus femoris muscle, and opposite to the upper part of the tuberosity of the ischium. The ramus of the ischium and the ilio-pubic symphysis were fractured, in consequence of which the injury cannot strictly be considered a simple case of a new anomalous dislocation.

The ball of the femur has been found in some other situations than those mentioned above ; but so far as my reading extends, in almost all such recorded cases, other injuries, such as fractures, have accompanied the displacement, so that these cases cannot properly be considered as examples of new dislocations, but rather as showing how the combination of other injuries with dislocation may affect the position of the bone.

DISLOCATIONS OF THE PATELLA.

The patella is liable to three dislocations, two of them common, and the third, of which there are some varieties, extremely rare, and difficult of reduction. The common dislocations are inwards and outwards, the latter being much the more frequent. They may be complete or partial. In the third dislocation, the bone undergoes a semi-revolution on its long axis, so that only one of its edges is in contact with the femur.

Each lateral dislocation may be the consequence of direct violence, but the dislocation outwards is often occasioned by muscular contraction. See causes of dislocations in the section on Dislocations in general.

Symptoms.—The knee is immovable to both the patient and the surgeon ; there is an unnatural depression in front of the joint, and an unusual swelling on the inner or outer side of the femur, according to the direction of the dislocation.

Treatment.—Reduction is effected by raising the trunk to the erect posture, elevating the leg so as to relax the rectus and triceps muscles, and then pressing the patella inwards or outwards according to the nature of the injury. Dislocation outwards has sometimes been reduced by elevating the limb and producing forcible flexion of the knee-joint.

The dislocation in which the patella makes a semi-revolution on its own axis, so as to have one of its margins in contact with the femur and the other with the integument, is so very rare that, as far as I know, there are only three cases recorded.

One case, that of a private of the 2d Life Guards, was successfully

treated by Mr. Mayo and Mr. Broughton. The injury was caused by a stroke on the right knee from the knee of another soldier, as the two opposite lines rode through each other. One edge of the patella rested on the outer surface of the external condyle, the other was directed outwards, and the fore part of the patella was directed forwards and inwards. Various methods were tried without success to effect reduction, which was at length accomplished by suddenly bending the knee so as to carry the heel back to the hip, when the patella returned to its proper situation.

In this case, one edge of the bone was in contact with the outer part of the external condyle; but in each of the other two cases, the one edge was in contact with the trochanter of the femur, and the other directed forwards. Of these two cases, one occurred in the experience of Mr. Welling, surgeon, at Hastings, and in that instance the integuments were very much elevated in front of the joint by one edge of the bone, the other edge resting against the femur. Replacement was effected by pressing the edges in opposite directions while the leg was extended.

The other case is published in a German journal, "*Rust's Magazin*," and is quoted in the "*London Medical Gazette*." The accident happened to a young hussar, who was riding without stirrups, and was occasioned, as in the case first mentioned, by the knee having been forcibly struck by a soldier in the opposite rank. The patella was half turned on its axis, so as to have one edge directed backwards and resting on the outer edge of the trochlea of the femur, while the other edge projected directly forwards; the posterior surface was directed outwards, and the anterior inwards.

The surgeon, finding it impossible by any force to restore the patella to its proper situation, had recourse to the expedient of cutting through the quadriceps tendon, where it is attached to the patella, but not even then could he effect replacement. Unhappily the incision extended into the joint, and was followed by suppuration, in consequence of which the patient died about eleven months after the accident.

DISLOCATIONS OF THE TIBIA FROM THE FEMUR.

The tibia may be dislocated in four directions,—inwards, outwards, backwards, or forwards. The last two are complete; the other two, or lateral dislocations, are partial.

THE LATERAL DISLOCATIONS.

The two lateral dislocations are easily distinguished by the appearance of the deformity, and the immovable condition of the joint. They are reduced by extension and counter-extension, and by pressing the tibia inwards or outwards, according to the direction of the dislocation. The external condyle of the femur, in the dislocation outwards, rests on the internal condyle of the tibia; in the dislocation inwards, the internal condyle of the femur rests on the external condyle of the tibia. In both dislocations the tibia is a little twisted.

DISLOCATION FORWARDS.

Symptoms.—The symptoms of this dislocation,—are a great swelling in the popliteal region, caused by the under extremity of the femur, and another in front of the femur, caused by the tibia, patella, and fibula being driven upwards and forwards upon it; a shortening of the leg, to an extent varying according to the distance that the tibia is sent up upon the femur; a very slight flexion of the leg upon the thigh, so as to form a very obtuse angle; and the extremely unnatural appearance caused by the deformity. In some cases, the pain has been very severe, and from the pressure of the femur against the popliteal artery, the pulsation of the anterior tibial artery has been found in some examples to be interrupted, in others the condition of the vessel has not been observed.

Reduction.—Reduction is easily accomplished by counter-extension applied to the thigh, and extension to the leg, in the direction of the long axis of the displaced tibia; and while these are being employed by assistants, the surgeon, placing one hand on the popliteal space against the extremity of the femur, and the other in front of the joint against the tibia, presses in opposite directions so as to send the femur upwards and forwards, and the tibia downwards and backwards. After reduction, the limb should be laid straight, and precautions taken to prevent inflammation. If, notwithstanding these precautions, inflammation should occur, active remedies must at once be employed to subdue it.

DISLOCATION BACKWARDS.

Symptoms.—A shortened state of the limb, the leg bent very much forward, a swelling in the popliteal space caused by the tibia, another in front, caused by the femur, and a great depression below it, in the situation of the ligamentum patellæ, are the symptoms of this dislocation.

Reduction.—The method of reduction is the same as in the last dislocation, except that the surgeon should press the extremity of the femur upwards and backwards, and the head of the tibia downwards and forwards, while extension and counter-extension are being made.

DISLOCATIONS OF THE ANKLE JOINT.

The ankle joint, which is formed by three bones, the tibia, fibula, and astragalus, and strengthened by five ligaments, the two tibio-tarsal and the three peroneo-tarsal, is liable to five dislocations. The tibia may be displaced from the astragalus, inwards, outwards, completely forwards, partially forwards, and backwards.

DISLOCATION OF THE TIBIA INWARDS.

Symptoms.—This dislocation may be readily distinguished by the great projection of the malleolus externus against the common integument, by the foot being turned outwards, by its inner edge being directed downwards, and by the depression about two or three inches above the malleolus externus, where crepitus may be easily detected. The pain is very great, and the swelling considerable; the foot can be moved by

the surgeon without difficulty, and when the patient is in the erect attitude, the inner edge only can be applied to the ground.

Fig. 83.



State of the Parts.—The tibia is drawn inwards, and before it can be brought into this position the tibio-tarsal ligaments must be ruptured, and the fibula fractured. This fracture takes place about two or three inches above the joint, and furnishes an explanation of some of the symptoms above mentioned. The under part of the fibula remains attached to the tarsus by the peroneo-tarsal ligaments which are entire.

Fig. 84.



aspect, is carried inwards along with the part of the fibula above the fracture.

Besides fracture of the fibula and rupture of the tibio-tarsal ligaments—conditions which always exist in this accident, there is often oblique fracture of the tibia, directed so as to break off from the shaft of the bone that part of the tibia which enters into the formation of the inferior tibio-fibular articulation. The fragment thus broken off remains connected with the malleolus externus, while the tibia, entire along the whole of its inner

Treatment.—For accomplishing reduction, the surgeon should direct the patient to be placed upon his back, with the thigh raised perpendicularly, and the leg bent back so as to make a right angle with the thigh. In this position the gastrocnemius muscle will be relaxed, and the extremity will be conveniently placed for applying the necessary extension and counter-extension. Surgeons have sometimes experienced difficulty in accomplishing reduction, from attempting it when the limb is extended, and the gastrocnemius thereby put upon the stretch. One assistant should afford the necessary counter-extension by holding the thigh, and another the necessary extension, by drawing the foot in a line with the long axis of the leg, preserving the foot, at the same time, midway between flexion and extension of the ankle joint, while the surgeon endeavours to press the tibia outwards, so as to bring it into contact with the upper surface of the astragalus. After reduction, the limb should be placed upon the posterior part, with the leg a little bent on the thigh, and the foot midway between flexion and extension,—a position which will be favourable to the uniform relaxation of the muscles. Until the fibula becomes entire, and the tibio-tarsal ligaments unite, appliances must be used for preventing the foot from being drawn outwards; for which purpose, two splints, each having a foot-piece, may be employed, or one splint without a foot-piece, applied to the inner, and one, with a foot-piece, applied to the outer side, to compensate for the want of resistance naturally offered by the fibula to the foot being drawn outwards. The most suitable means for keeping the splints in their proper position are loop or buckle-bandages. Some cotton-wool should be used to prevent the splints from pressing unpleasantly against the limb and foot. A point of the very greatest importance is to apply the splints so very loosely at first, as to make it impossible for them to prove injurious by producing pressure upon the affected parts, which often swell to a very considerable extent, in consequence of inflammation supervening. After what has been stated regarding the different varieties of apparatus for retaining the foot in its proper position in fractures, it is unnecessary here to refer to other appliances for the treatment of lateral dislocations of the ankle; for a description of them, and their mode of operation, I beg to refer to the section on Fractures of the leg.

DISLOCATION OF THE TIBIA OUTWARDS.

Symptoms.—The malleolus externus projects against the common integument, forming a remarkable swelling in that situation, the foot is turned inwards and its outer edge rests upon the ground.

State of the Parts.—The tibia cannot be sent to the outer side of the astragalus, the position which it occupies in this dislocation, without the malleolus internus being fractured. The dissevered malleolus remains attached to the tarsus by the tibio-tarsal ligaments. The fibula is sent outwards from the tarsus, and the peroneo-tarsal ligaments are usually ruptured; sometimes they are entire, but in that case the fibula is fractured above the malleolus, and the under part of the fragment remains attached to the tarsus, while the upper part of the same fragment is bent

outwards. The condition of the parts, therefore, may be stated to

Fig. 85.



be,—that the malleolus internus is broken off from the tibia, and remains attached to the tarsus by the tibio-tarsal ligaments, and the peroneo-tarsal ligaments are ruptured; or, the two malleoli are fractured, and the peroneo-tarsal ligaments are entire. That such are the conditions in this dislocation I am fully satisfied.

Treatment.—The method of reduction differs from that in the former dislocation only in this respect, that the surgeon presses the bones inwards instead of outwards. After reduction, the attitude and the treatment are precisely the same, except that if one splint only have a foot-piece, it must be applied to the inner instead of the outer side; because the object of the foot-piece is to preserve the foot in its proper position, and in this dislocation the foot has a tendency to be drawn inwards. This dislocation may also be very conveniently treated by the different appliances mentioned in the description of the treatment of fractures of the

leg. In the two lateral dislocations, if Dupuytren's splint be used, it must always be fixed to the side opposite to that towards which the foot is in danger of being drawn; because, in this case, it is not the splint that prevents displacement, but the bandage, which fixes the foot to the splint.

DISLOCATIONS FORWARDS.

These, as has been already stated, are two, the complete, and the partial.

Symptoms.—The heel is lengthened, fixed, and drawn upwards, the part of the foot before the leg is proportionally shortened, and the toes are depressed. These symptoms in the two dislocations differ merely as to their extent. In the complete dislocation, there is an evident depression in front of the tendo Achillis, and the foot is even more rigidly fixed than in the partial dislocation.

State of the Parts.—In the complete dislocation, the fibula is fractured, and the fragment remains attached to the tarsus by the peroneo-tarsal ligaments, the tibio-tarsal ligaments are ruptured, and the tibia rests on the os naviculare, and the os cuneiforme internum. In the partial dislocation, also, the fibula has been found fractured, the tibio-

tarsal ligaments ruptured, and the tibia resting partly on the astragalus, and partly on the os naviculare.

Treatment.—Reduction is accomplished as in the lateral dislocations, except that the bones of the leg should be pressed backwards while extension and counter-extension are being made, and the extension applied to the foot should be directed so as to bring the astragalus in a line with the long axis of the leg. The limb should be placed in the same attitude as in the former dislocations, and by bandaging the leg and foot to two splints with foot-pieces, it is possible to keep the bones of the leg from slipping forwards; but by far the most efficient and convenient retentive apparatus for the treatment of this injury is Amesbury's double-inclined plane. By means of it the bones of the leg can easily be kept from sliding forwards, until the fractured portions of the tibia unite, and the ruptured ligaments are restored.

DISLOCATION OF THE TIBIA BACKWARDS.

This is an extremely rare injury. I once had an opportunity of seeing an example of it in a girl fourteen years of age. When I saw the patient, about two years had elapsed since the occurrence of the dislocation, and no attempt had been made meanwhile, to accomplish reduction; the surgeon who first saw the case after the injury, not understanding the nature of it. The symptoms were,—great lengthening of the foot before the two malleoli; the heel and back of the leg were in a line with each other, so that there was no projection whatever of the foot behind the leg; the malleoli did not appear to have been fractured, but were equally driven backwards, so as to bear their natural relations to each other; and the foot did not present any twisted appearance. When the girl was raised to the erect attitude, and when she pressed with any weight upon the foot, its anterior extremity bent upwards, in consequence of which she was unable to use the foot in walking. In this case, the tibio-tarsal and peroneo-tarsal ligaments must have been ruptured; the malleoli appeared to be free from fracture, and the tibia rested upon the upper part of the calcaneum.

Treatment.—For accomplishing reduction in a recent case, the patient should be placed in the same attitude as in the reduction of the former dislocations; counter-extension should be applied to the thigh by one assistant, and extension to the foot by another; and while the foot is being drawn in a line with the long axis of the leg, it ought, at the same time, to be carried backwards, so as to bring the astragalus underneath the tibia. While counter-extension and extension are being made, the surgeon should endeavour to press the tibia forwards. Amesbury's double-inclined plane, with a large pad placed between the splint and the back of the leg, immediately above the heel, will be found the most convenient retentive apparatus.

COMPOUND OR OPEN DISLOCATION OF THE ANKLE JOINT.

Together with displacement of the bones of the leg in any of the directions above referred to, there may also be a wound of the soft parts, laying open the cavity of the joint, constituting what is called a compound or open dislocation. The cause of the wound may be the protrusion of the bones through the soft parts, or the tearing of the soft parts

by some hard body, against which the limb may have been pressed. The former is the more frequent cause, but in whatever way produced, this injury is always of a very serious character. Inflammation of the synovial membrane, and irritative fever, are the consequences of this condition; and extensive suppuration, destruction of the cartilages, and gangrene of the soft tissues are the local results principally to be dreaded from that inflammation. These open dislocations were at one time considered to be so dangerous, that immediate amputation was deemed not merely expedient, but absolutely necessary to save the life of the patient. But in so many cases, even with serious complications, the limb has been saved, and the treatment been successful, that no surgeon of the present day would think of amputating on account of a dislocation being compound, unless it were attended by other unfavourable complications. In the greater number of cases, the practice to be followed is, to reduce the dislocation, bring the edges of the wound together, and treat the case as the common rules of surgery indicate.

There are, however, certain conditions which render amputation advisable and necessary, the principal of which are:—an extremely shattered condition of the bones; a very extensively lacerated wound; severe and extensive contusion of soft parts about the joint, so as to make it probable that sloughing will take place; division of the larger blood-vessels, together with an extensive wound; a very irritable or debilitated constitution; or the advanced age of the patient. Such are the chief circumstances which render it judicious for the surgeon to recommend immediate amputation, rather than endanger the life of the patient by attempting to save the limb. When amputation is deemed necessary, the proper period for its performance is before the occurrence of irritative fever: if that period be allowed to pass by, another may not occur in which the operation could with propriety be performed. The above conditions in many instances justify immediate amputation. Sometimes, when attempts have been made to avoid amputation in the first instance, it has been ultimately rendered indispensable by extensive suppuration, or by destruction of portions of the bones keeping up constant irritation in the system, or by gangrene of the foot. When this last condition occurs, it is exceedingly desirable to have the limits of the gangrene fixed before the operation be attempted; although it has been ascertained, that it is not so absolutely indispensable to have limits set in gangrene arising from destruction of vessels in a healthy person, as in gangrene arising from a constitutional cause.

I shall conclude the subject of compound dislocation of the ankle joint with the following quotation from the work of Sir Astley Cooper.

“Persons who are much *loaded with adeps* are generally very irritable, and bear important accidents very ill; indeed they frequently perish, whatever plan of treatment is pursued: to this statement, however, there are exceptions in those who, though corpulent, are still in the habit of taking much exercise, as they will retain some vigour of constitution; and in such persons the limb may be attempted to be saved as in the case described by Mr. Abbot, surgeon, at Needham Market; but in those who have become extremely fat, and who have been addicted to habits of indolence, there is but little chance of preserving life but by amputation.”

CHAPTER VIII.

AFFECTIONS OF THE OSSEOUS SYSTEM.

PERIOSTITIS.

SIR PHILIP CRAMPTON, of Dublin, who first gave this name to inflammation of the periosteum, has the merit of being the first person who gave a description of that form of the disease which proceeds from cold or external injury, and is called Idiopathic, to distinguish it from the symptomatic form, which is the effect of scrofula, syphilis, or the injudicious use of mercury. Professor Graves, of Dublin, in his excellent Clinical Lectures, divides this disease into two forms,—the diffused and the circumscribed, the former corresponding with the idiopathic, the latter with the symptomatic of Sir Philip Crampton.

Periostitis may be either acute or chronic. When it occurs in a person of sound constitution, and is occasioned by cold or external injury, it is usually acute; when it is of the symptomatic or circumscribed form, it is generally chronic; and when it is excited by external causes in a person predisposed to the disease by scrofula, syphilis, or the too free use of mercury, it often exhibits both the acute and the chronic form.

Causes.—The causes of periostitis may be divided into exciting, and predisposing. Of idiopathic periostitis the exciting causes are atmospheric influence, and mechanical injury; the predisposing causes, a feeble, debilitated state of body, induced by mental anxiety, or long-continued derangement of the digestive apparatus. Of symptomatic periostitis, the exciting causes,—although this form of the disease sometimes occurs without any known exciting cause,—are the same as those of the idiopathic form. The predisposing causes are scrofula, syphilis, or an irritable condition of the constitution caused by the prejudicial use of mercury. If in any unfortunate person, the subject of an attack of periostitis, “the triumvirate of scrofula, syphilis, and mercury,” as an excellent writer has expressed himself, should chance to meet, the symptomatic form will be, in all probability, of the very worst kind. The causes may be, therefore termed the external or exciting, and the internal or predisposing.

Periostitis is most common to bones situated near the surface of the body, as the cranium, clavicle, sternum, and tibia: the pericranium over the frontal bone, on account of its exposed situation, is frequently the subject of the disease; sometimes also the periosteum of the humerus is attacked by it, and occasionally that of the femur.

Symptoms.—The symptoms in some degree differ according as the disease is of the acute or chronic form. We shall, however, consider the symptoms of both forms together, noticing the differences as we proceed.

Deep-seated pain is one of the earliest and most urgent symptoms. It is severe on account of the unyielding nature of the tissue affected, and is of a girding nature, and in some conditions attended with throbbing. In acute periostitis it is constant, and, like the pain caused by inflammations of the most hard tissues, is characterized by remissions and periodical exacerbations; the exacerbations occurring during the night, when the pain is often most excruciating. In the chronic form, the pain is so much diminished during the day, as to be intermittent; but the nocturnal exacerbations are particularly distressing.

Together with pain, there is *extreme tenderness on pressure*, sometimes amounting even to intolerance of touch. This symptom is much greater in periostitis than in osteitis.

Swelling is, comparatively speaking, an early symptom, and is also subject to variety during the different stages of the disease. In the first stage, the swelling is of an elastic, tense, doughy feeling, dependent on the swollen condition of the periosteum itself; it may afterwards become oedematous, from effusion into the cellular tissue external to the periosteum, but there is always the elastic feeling underneath this oedema. The ultimate character, however, of the swelling will vary, both as to hardness and extent, according as the periostitis is acute or chronic. The varieties and conditions on which they depend, will be understood from the description of the state of the parts given in another page. Often in the very chronic form, the swelling, at first elastic, ultimately becomes quite hard; but it is only in this form, and after long continuance of it, that we find on pressing it firmly with the fingers, that rigid, incompressible hardness which characterizes swelling of the bone itself. The skin is at first pale, and not involved in the disease; but if the disease be acute, the swelling, sooner or later, becomes diffused, and the skin red, tense, tender, and glistening.

Constitutional Symptoms.—Periostitis is accompanied with evident constitutional symptoms. In the acute form they are the same as those of inflammatory fever, but of a more aggravated character, and attended with great derangement of the digestive apparatus. In the chronic form the patient becomes pallid, weak, relaxed, and emaciated, from continued irritation and want of sleep, and exhibits the symptoms of hectic fever. In short, the accompanying fever is of the inflammatory type in acute, and ere long becomes of the hectic type in chronic periostitis. There is, however, one condition of the acute form of the disease, in which the inflammatory fever which attends the very commencement, is speedily converted into hectic fever; namely, when suppuration takes place to a great extent.

State of the Parts.—One of the earliest pathological changes is increased vascularity of the periosteum. In the acute form the periosteum is thickened and softened, while in the chronic it is thickened, and its density increased. Sometimes it is thickened without effusion under it, and then there may be increased adhesion of the periosteum to the

bone, with increased vascularity of the bone; and this, if not relieved, may, after considerable suffering and derangement of the general health, terminate in the conversion of the periosteum into a fibro-cartilaginous substance. This is usually attended at last with some swelling of the bone itself. If there be no subsidence of the inflammation in periostitis, effusion may take place both inside and outside the periosteum; effusion of serous fluid into the surrounding cellular tissue giving rise to oedema, and secretion of fibrin taking place underneath the periosteum between it and the bone. The secretion of fibrin under the periosteum is more likely to take place in the chronic form, and is termed by some the gelatinous effusion. "The bone," Mr. Liston observes, "is imbedded in a gelatinous or lymphatic effusion situated mostly beneath the periosteum." Inflammatory or recent node is the name distinguishing this raised condition of the periosteum caused by the effusion of lymph; and if the inflammation does not go on to a more acute stage, the effusion may be converted into cartilage, and then into bone, forming permanent node. Other products of inflammation may be formed in the acute variety: if the inflammation be great, purulent matter may be formed between the periosteum and the bone, causing separation of the periosteum. Sometimes the separation is extensive, and necrosis of the bone from inflammation, and from the loss of its nutritive membrane, may be the result. It is when the suppuration is extensive and takes place very speedily, that the inflammatory fever which attends the very beginning of the disease may be so quickly converted into the hectic type. There is a form of periostitis termed by some paronychia periostei, or the deep-seated paronychia, or whitlow, and by others the paronychia maligna. This is an example of severe acute periostitis, and affects the phalanges of the fingers and their periosteum. In this variety the pain of the finger is excessive; it feels as if it would burst; there is great oedema and swelling of the hand, and often the whole finger appears as if affected with erysipelatous inflammation. Suppuration to a considerable extent, sloughing of the soft parts, and destruction of some of the bones are sometimes consequences of this form of periostitis.

Treatment.—The mode of treatment differs in the acute and chronic forms.

In the acute form, the constitutional treatment consists of low diet, general depletion, saline purgatives, diaphoretic medicines, and such means as are capable of procuring resolution. The local treatment includes quiet, an attitude favourable to the reflux of the venous blood, leeches, warm and emollient applications, as fomentations, poultices, and other antiphlogistic means. Free division of the periosteum should be employed, according to some, only when other treatment has failed. Professor Miller objects to free direct division if suppuration be not present, and recommends a valvular division of the inflamed periosteum. Professor Syme says, "The mode of treatment depends upon the intensity of the symptoms. When they are very violent and attended with smart fever, the most effectual practice is to make a free incision through the inflamed parts down to the bone. When less severe, no benefit is derived from this proceeding."

"Free incisions," says Mr. Liston, "through the periosteum some-

times relieve the pain, and cut short the disease, the distended vessels being thereby emptied ; but such practice is only a last resource, when the action has resisted all other means and threatens an unfavourable termination." If, in the acute form, the inflammation proceeds to suppuration, free division is the more necessary. But whether suppuration be present or not, the distended vessels ought to be relieved by early free direct incision, if other treatment prove unsuccessful.

In the chronic form, the constitutional treatment consists in the exhibition of internal alterative remedies, as hydriodate of potass, which, to prove efficacious, must be administered in pretty large quantities, say of about ten grains in divided doses during the day. It may be given in water, or combined with sarsaparilla, which is itself an excellent alterative. Some authors deprecate the employment of powerful alteratives, unless all others have failed. Mercurial alteratives are found exceedingly useful in relieving chronic periostitis, and should be tried, if the body be not exceedingly irritable, and if the above treatment have not had the desired effect. It seems strange that mercury, a predisposing cause of periostitis, should prove a remedy ; yet that it does so, is an ascertained fact. Bichloride of mercury answers well, and may be given in doses of a tenth of a grain twice or thrice a day, either made into a pill, or in solution in sarsaparilla. "General chronic periostitis, which is produced by exposure to cold, or occurs often during mercurial courses, and is often supposed to be a symptom of syphilis, is relieved by the internal exhibition of bichloride of mercury, or other mercurial preparations, combined with sarsaparilla and diaphoretics. In many instances such an affection will yield to no other treatment, and thus the practitioner is occasionally obliged to have recourse to a somewhat paradoxical practice, that of giving mercury for a disease which seems to have been produced by that mineral." The foregoing passage is borrowed from Mr. Liston's "Elements of Surgery." Upon this point Mr. Lawrence remarks ;—"I have seen, in so many instances, the pain in that disease continue unrelieved, in spite of the pretty active employment of local antiphlogistic means, in spite of mild mercurial treatment, and have so constantly found it yield only to the full influence of mercury on the system, that I own myself to be at a considerable loss to account for the opinion entertained by many, that inflammation of the periosteum and affections of the bone are actually brought on by the use of mercury. It seems to me to be very inconsistent that one and the same medicine should be capable of decidedly relieving inflammation of a certain texture, and that when employed for other purposes it should actually produce inflammation of that very texture. I think I formerly had occasion to mention that I did not coincide with the opinion of many, that those states were produced by the mercury, and certainly, when speaking of inflammation of the periosteum, whether arising from syphilis or not, I do not know of any means so capable of relieving the disorder as mercury.

Local Treatment comprises the use of some of the different forms of counter-irritants. Blisters are sometimes very useful ; and in some cases the local application of an alterative, as mercurial ointment rubbed

into the part, or painting it frequently with tincture of iodine, may be found beneficial.

NEURALGIA PERIOSTEI.

This very painful affection sometimes follows amputations, or slight injuries of a bone; sometimes it affects the periosteum of the ribs and sternum in cases of spinal irritation or uterine derangement, when a morbid sensibility in the sentient extremities of nerves is by no means an unusual condition; and sometimes it comes on without any known exciting cause. The disease generally affects females of weak constitution, though males of an irritable habit are also subject to it. I have met with many examples of this affection in females of a hysterical habit, and two instances of it I have seen in males, one of the periosteum of the ribs in a young man who died of phthisis, and the other of the periosteum of the humerus in a gentleman who never had any complaint beyond derangement of the digestive apparatus, and neuralgic pains about the face.

Symptoms.—One of the earliest and most urgent symptoms is severe pain, of a sharp neuralgic kind, sometimes so severe as to deprive the patient of sleep; and like all neuralgic pains, intermitting, and often periodically recurring. Extreme tenderness on pressure is often a symptom, and in some cases the nervous sensibility is so much exalted that the slightest touch is painful. Sometimes, but not always, this tenderness to touch extends to the common integument. In the example of the affection which I met with in the periosteum covering the ribs, the integuments could be pinched up, and pressure directed against the intercostal spaces without causing any uneasiness; but the slightest pressure directed against the ribs occasioned great pain. Mr. Thomas Spencer Wells, in an excellent article on diseases of the bones, in the "Cyclopædia of Practical Surgery," states, that he met with two examples of this affection of the periosteum covering the ribs in two young men who had fallen into phthisis after syphilis and the too free use of mercury; and in both these instances the pain on pressure was entirely confined to the periosteum. The only opportunity I have had of examining the periosteum after death, was in the case of phthisis above referred to. There was not the slightest trace of inflammation, nor any apparent change whatever in either the periosteum or the bone; and though there have been many cases, in which persons who had suffered from this affection, have been examined after death arising from other causes, without the surgeon having been able to detect any trace of vascular hyperæmia. The conclusion drawn from hence is, that neuralgia periosteï depends upon a painful exaltation of the function of the sentient nerves of the periosteum.

Treatment.—This disease must be combatted by general and local treatment. The object aimed at by general treatment is to give increased tone and strength to the system, and the means to be used for this purpose must be suited to the particular state of the patient. Exercise and free exposure in the open air, a generous diet, and the due regulation of the bowels, together with tonics, such as preparations of iron, and more particularly the carbonate and the saccharated carbonate

of iron, are prescribed with advantage when the patient is not suffering from any other disease, and when no symptoms appear indicating that their employment would be prejudicial. As local applications, different anodyne liniments, and plasters containing opium or belladonna, or both, are useful. I have often prescribed, apparently with advantage, a liniment of equal parts of the tincture of belladonna, and the tincture of opium, to be kept constantly over the part; and I have seen plasters containing large quantities of belladonna or opium, or both, very serviceable; liniments and plasters containing aconite, are also very useful. The above are the only local applications of which I have had any experience, with the exception of the endermoid application of nitrate of silver, which I have known to prove exceedingly useful.

OSTITIS.

Ostitis is the name given to inflammation of bone. It may arise from cold, external injury, periostitis, or neglected or improperly treated phlegmonous erysipelas:—in the latter case, the inflammation spreads from the soft parts to the periosteum and bone, so that they become secondarily affected. It is also often induced by inflammation of the synovial membrane at the extremity of a bone. These may be called the external and exciting causes; and when they induce the disease in a person of sound constitution, it is then said to be *simple* ostitis; but when the constitution of the patient has been previously affected by scrofula, syphilis, or mercury, which are predisposing causes, the diseased action is then modified by the general state of the system, and the ostitis is termed *specific*. It is of importance to understand how far the inflammation of the specific forms can be distinguished from that of the simple by their effects, and to ascertain as far as they are known, the characteristic appearances of each. Ostitis may not only be either simple or specific, but also like other inflammations, either acute or chronic.

Symptoms.—In the acute form, one of the earliest symptoms is deep-seated agonizing pain, which by the patient is referred to the bone. The pain is even more excruciating than in periostitis, and is of a bursting kind. It is less aggravated by pressure than periostitis, and, as in that disease, it has nocturnal exacerbations. In the acute forms there are occasional remissions of the pain, but in the chronic form there are often complete intermissions. The pain is increased by motion of the limb, and by the dependent posture. In ostitis, tenderness to the touch at first is slight; in periostitis it is the reverse, so that this symptom is diagnostic at an early stage of the disease; but afterwards the periosteum becomes inflamed, and then there is the same acute tenderness as when that membrane is primarily affected. Swelling is long before it makes its appearance, and when it does, it is for some time hard, solid, and diffused, afterwards it becomes cedematous from effusion into the cellular tissue, and the soft tissues over the bone at last present the ordinary local symptoms of inflammation. The constitutional symptoms are those of inflammatory fever, and their violence will depend on the intensity, extent, and duration of the disease, and the susceptibility of the constitution to sympathize with the local action.

In the chronic form, pain is the earliest symptom. Compared, however, with the pain in the acute form, it is inconsiderable; and while it has distinct exacerbations during the night, it is always marked by decided remissions, and often by complete intermissions during the day:—this is for a long time the only local symptom. Swelling is long before making its appearance, and when it does, it is much more circumscribed than in the acute form, and is characterized by an unyielding incompressible hardness. If the periosteum become affected, the swelling will at last present the character of the same symptom in chronic periostitis; but it is slower in its progress, and longer in making its appearance, than in that disease. In the early stage, pressure has little or no effect in aggravating the pain, and it is often a long time before the patient complains of tenderness when the bone is pressed. There is very little sympathetic effect produced in other parts of the system until the disease has been of long standing; and when the continuance of the nocturnal exacerbations and want of rest cause constitutional disturbance, the fever is of the hectic type.

State of the Parts.—The changes produced in the osseous structure, by acute inflammation, during the period of its activity, and before reaching suppuration, whether external, internal, or general, simple or carious ulceration, or some of the different forms of necrosis, are but imperfectly known. The blood-vessels have been found more numerous and distended than natural. The bone becomes softened, apparently from absorption of part of its earthy matter, its cancellated texture appears unusually open, the lamellæ are thinned, and the haversian canals become preternaturally large, as if the distended vessels pressed aside the softened structure. This last-mentioned condition sometimes gives the bone, especially on the surface, a porous appearance. Exudation takes place both into the cells and into the haversian canals. Such are the principal conditions produced, in the first instance, by acute inflammation in a bone not the subject of any previous unhealthy deposit. After some time, the following changes may take place in acute ostitis. The inflammation may result in resolution, or in one of the varieties of suppuration, which will afterwards be described; or it may lead to simple or carious ulceration, or to necrosis. If the inflammation be of a more chronic character, other changes may take place. Sometimes the bone becomes expanded or enlarged, and, at the same time, especially in syphilitic patients, consolidated, and its weight increased. These changes, caused by the plastic exudation passing into bone, may either affect the entire bone, or be confined to a particular region of it, which has been more especially the subject of inflammation. This osseous formation taking place upon the inner surface of the haversian canals, their cavities become more or less filled up, so that in many cases, a section of the diseased part presents a nearly uniform ivory-like texture, in which few orifices appear. Sometimes these deposits are in the cavities of the long bones, making them almost solid throughout; and often, they are found on the surface, occasioning protuberances, rendering the bone rough or uneven, and considerably altering its figure and appearance. In scrofulous subjects, the bone becomes very much lighter than natural, and is filled with a cheese-like substance. In some

specimens in my collection, this substance occupies only part of a bone; in others it extends through almost the whole of a bone, occupying nearly the entire space within the shell, which is exceedingly thin, and in these instances the whole of the earthy matter is absorbed, except that which forms the very thin external shell. In other specimens, this peculiar deposit is equally extended through the whole of a bone, but seems to be diffused through the cancellated structure, which is not entirely absorbed. In some of the specimens, where this substance is general through the whole of a bone, and where the shell is very thin, there are small deposits of bone, forming osseous irregularities, or spicula, on the external surface. The colour of this substance is in some cases pure white, in some, yellowish white, and in others, reddish brown. In many cases, traces of inflammation accompany this cheese-like deposit, while in others, no such traces are apparent. It may result from previous perversion of nutrition, unattended with inflammation; or it may be a transformation of the liquor sanguinis exuded in consequence of a low grade of the inflammatory process, in a person of scrofulous diathesis. The subject of such deposits will be more particularly referred to in the description of tubercle, in the chapter on Tumours.

Treatment.—This may be summed up in a very few words. It is both general and local. In the acute form, the treatment is precisely the same as in periostitis, except that there is no necessity for incision. In all cases the treatment should be decided, that the inflammation may, if possible, be prevented from going on to suppuration or caries. The local and general depletion, however, must not be carried to too great an extent, as the consequent debility predisposes to caries. In the chronic form, the treatment consists locally, in the employment of the different counter-irritants; and internally, of the alterative remedies recommended in the treatment of periostitis; but it should be remembered that mercury, although often useful, ought to be exhibited with the greatest caution, as the interstitial absorption arising from the free use of this medicine in some forms of osteitis, increases the danger of the occurrence of caries.

SUPPURATION IN BONE.

Suppuration may be divided into three varieties—namely, external, internal, and general.

Of external suppuration, there are two kinds, acute and chronic; each presenting a different assemblage of symptoms, and requiring different treatment.

Acute External Suppuration, or acute external abscess, is a frequent consequence of periostitis, or osteitis, or both.

Symptoms.—Pain of an excruciating kind, attended with the other symptoms of osteitis, if that be the cause of the disease—rigors recurring at intervals, and swelling, which has a feeling of fluctuation. The integuments ultimately present the local symptoms of inflammation. Absorption, ulceration, caries, and even necrosis of the bone may be produced, if the purulent matter which burrows beneath the periosteum be not speedily evacuated.

Treatment.—Before the abscess is formed, the surgeon should endeavour to remove the inflammatory action by the usual antiphlogistic remedies; but after its formation the appropriate treatment is free, direct incision, which affords very great relief to the patient.

Chronic External Suppuration, or chronic external abscess, may be the consequence of an attack of chronic inflammation, which may have commenced in the bone, or in the periosteum, or in both of these tissues.

Symptoms.—These at first are the same as the symptoms of chronic periostitis, or chronic osteitis, or of both these diseases. After some time a swelling with fluctuation forms, unattended with the symptoms of acute inflammation. The swelling is generally small and circumscribed, just the reverse of what takes place in chronic abscess of the soft parts.

Treatment.—The treatment proper to be first tried is the same as in small chronic abscess of the soft tissues; accordingly all means likely to produce absorption should be employed. With this view it is necessary to improve the general health, and to enjoin dry and solid food, and abstinence from liquids; in addition to which, internal alterative remedies, as iodide of potassium, should be given in small quantities,—four or five grains in solution, in divided doses, during the day will often be found beneficial. The local treatment consists in the employment of various applications used to promote absorption. For this purpose it has, in many instances, been found advantageous to paint the part with the tincture of iodine, as frequently as the state of the skin will permit. A lotion of iodide of potassium, iodine, and water, of the proportions of 3ii of the iodide of potassium, 3i of iodine, and 3i of water, is sometimes used in the same manner as the tincture, and with good effect. Some apply blisters, from their well-known effect of sometimes promoting absorption; others use blisters, and dress the part with mercurial ointment. If these means do not effect a cure, a small *valvular* incision is necessary. If, through improper treatment, the chronic is converted into an acute abscess, free *direct* incision must be employed. Friction sometimes changes a chronic into an acute abscess. It sometimes happens in unhealthy constitutions, that, after injuries or amputations, very extensive collections of pus take place under the periosteum; and in some forms of phlebitis collections of purulent matter form without being preceded by accident or amputation; sometimes they happen as sequelæ of fever. They almost always prove fatal; yet, if the patient be healthy, he may recover after necrosis of the bone.

INTERNAL SUPPURATION.

Of this there are four varieties: namely, diffuse acute internal suppuration; limited acute internal suppuration; chronic internal suppuration; and scrofulous tubercular abscess of bone.

L. DIFFUSE ACUTE INTERNAL SUPPURATION, OR DIFFUSE ACUTE INTERNAL ABSCESS.

This follows as an effect of acute osteitis, of which it has the local and constitutional symptoms. If the patient do not sink under the disease, rigors and hectic fever supervene, and sooner or later there is an indis-

tinct undulation or fluctuation beneath the periosteum and the superimposed soft tissues which become involved. This disease depends upon diffuse inflammation within the bone, the matter occupying in the short bones the cancellated structure, and in the long cylindrical bones the canals, there being no tissue or sac to circumscribe it. The purulent matter destroys the cancellated structure, and some parts of the bone become very much absorbed. The canals for the transmission of vessels become enlarged, and through them and the apertures formed by the absorption of portions of the bone, the matter makes its way to the surface.

Treatment.—This is at first the same as in acute osteitis, and should be as decided as the circumstances of the case will admit. As soon as fluctuation is present, recourse must be had to free direct incisions. When hectic fever supervenes, the treatment must be tonic.

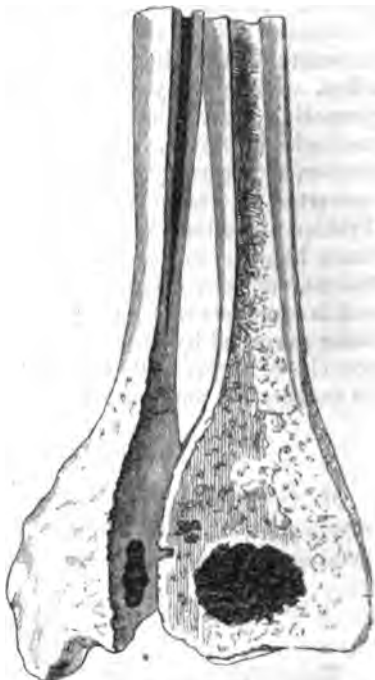
II. LIMITED ACUTE INTERNAL SUPPURATION, OR LIMITED ACUTE INTERNAL ABSCESS.

This usually takes place in the cancellated heads of the long bones, frequently in the head of the tibia, sometimes in its shaft, and sometimes in its under extremity, in persons about or beyond the middle period of life, who are exposed to cold and night air.

Fig. 86.



Fig. 87.



Symptoms.—The principal symptom is most excruciating pain. This has been found in some cases to be constant, and in others to be slight, or amounting only to uneasiness during the day, but in all liable to severe nocturnal exacerbations. It is referred by the patient to a particular spot, and is attended with a degree of throbbing and a sensation

of weight. As the disease advances, tenderness and pain are experienced when pressure is applied to the soft tissues and the part of the bone external to the disease. After some time the skin becomes red and slightly hot, but there is no swelling. The symptoms are aggravated by motion of the limb.

State of the Parts.—After the disease is fully formed, on making a section of the bone, there is observed a cavity or sac in its interior, having a distinct bony encasement. The interior of the cavity is lined with a vascular membrane, from which the exudation takes place which is transformed into pus. A lower degree of inflammation extends to the textures external to the bony encasement. In the museum of St. George's Hospital, there are several very beautiful and interesting specimens of this disease.

Treatment.—Sir Benjamin Brodie has the merit of having proposed the proper treatment, which consists in making a crucial incision of the soft parts, exposing the bone, and by means of a trephine sawing out a portion of it, so as to allow of the evacuation of the matter. Sir Benjamin Brodie has treated cases successfully in this way; Mr. Liston, in his "*Elements of Surgery*," records a very instructive case, in which the same practice was followed by the desired result; and many other cases have been treated with equal success. Figs. 88, 89, represent a

Fig. 88.



Fig. 89.



case in which the matter made its way to the surface, by its own efforts; but, from the firm nature of the new bony encasement which surrounds the matter, this is a result which can seldom be looked for.

III. CHRONIC INTERNAL SUPPURATION, OR CHRONIC INTERNAL ABSCESS.

Symptoms.—These, both local and general, are the same as those of chronic osteitis, although sometimes at first they indicate acute osteitis. Swelling of the bone soon occurs, and if the strength of the patient holds out, so that the disease runs its course, an indistinct undulation or fluctuation, depending upon the thin state of the bone, is at last perceptible to the touch. The constitutional symptoms are ultimately those of hectic fever.

State of the Parts.—As the name of the disease indicates, matter is formed, and it is contained in an indistinct cyst. "The result of the pressure of the abscess is to cause an absorption of the cancellated structure, and in this way the space for the increase of the abscess continues to be enlarged." The matter is thin and unhealthy, and is mixed with the debris of the bone. The cancellated tissue of the bone is dilated, and the integuments over the bone become inflamed.

Treatment.—This consists in free direct incision through the soft tissues and the shell of bone, which is, in consequence of disease, generally divisible by a strong scalpel. After the evacuation of the matter, it is advisable to inject sulphate of zinc lotion into the interior of the bone, to employ gentle lateral compression and support, and at the same time to enjoin rest, and adopt judicious measures for supporting the general strength.

IV. SCROFULOUS TUBERCULAR ABSCESS OF BONE.

Symptoms.—This affection which, as the name indicates, is met with in persons of a scrofulous habit, is at first characterized by a sense of weight and uneasiness in the diseased part, not amounting to pain. This sensation is referred to a particular part, and is increased by pressure and by motion, and sometimes by the heat of bed. Enlargement of the osseous tissue takes place, followed by oedematous swelling of the soft parts, and the integument presents a bluish colour. In the suppurative stage the uneasiness is changed into actual pain, and the enlargement increases more rapidly. The matter, sometimes, makes its way to the surface, in which case, a swelling with fluctuation will be perceptible. On being discharged, it presents the ordinary characters of such collections in scrofulous habits; and the cavity has no tendency to heal, but continues to throw out an offensive discharge. Such collections, instead of making their way to the surface, frequently open into the neighbouring articulation; and in that case there is great increase of pain, and of the other local symptoms, together with pretty decided symptoms of irritative fever, which soon change to those of the hectic type. Except when the disease opens into an articulation, it is not accompanied by any strongly-marked symptoms of inflammatory fever; but in all cases it, sooner or later, gives rise to hectic fever.

State of the Parts.—The cancellated structure of the bone, especially of the heads of the bones, is filled with scrofulous, or tubercular matter. This substance first fills the cells, and by the accumulation of it, the cancellated tissue of the bone becomes absorbed, and its place occupied by the deposit. The morbid deposit may be the result of previous perversion of nutrition, or the change of liquor sanguinis exuded in consequence either of congestion or a slight grade of the inflammatory process. The change of the liquor sanguinis into scrofulous or tubercular deposit, is believed to depend on the constitution or inherent composition of the exudation. The constitution is supposed to be determined by that of the blood; and such being the case, the importance becomes evident of attending to the nature of the food, of promoting the proper performance of the functions of the digestive organs, and of guarding against everything calculated to operate unfavourably on the composition and proper-

ties of the blood. In its progress, the disease comes to be accompanied with a degree of inflammation, which proceeds to suppuration.

Treatment.—This local affection is very much influenced by the state of the general health, which therefore requires to be particularly attended to through all its different stages. The formation of the tubercular deposit in the cancellated structure of the bone is the first deviation from its sound condition. The conditions in which that formation is most apt to take place, are believed to be the scrofulous diathesis, together with a weak state of the general health. It is often found in persons of that habit who have been confined to situations where the air is impure, cold, or damp; who have lived on a diet not sufficiently nutritious; who have not enjoyed regular exercise and exposure in the open air; or who have been subjected to any particular cause of debility. If the presence of the deposit be suspected, the endeavour must be made to limit its extent, and to delay the suppuration by removing the patient from the influences which excite unhealthy secretion. For that purpose free exposure in the open air, generous diet and the use of such medicines as from the particular state of the patient are most likely to improve the general health, must be strictly enjoined. Tonic medicines, and more especially the preparations of iron, are useful; but as permanent strength can be communicated only by the proper assimilation of nourishment, those remedies should be used which, from the particular state of the patient's health, are most likely to fit the digestive organ for the reception and proper digestion of food. Of all remedies cod-liver oil is the most valuable in this, as well as in other scrofulous affections. Limitation of the tubercular deposit, and prevention of suppuration are obviously paramount indications. When suppuration does take place, the pain should be mitigated by fomentations and rest of the affected part, and the matter should be evacuated as soon as its presence is detected. Sometimes counter-irritation by means of a blister gives some relief from the pain; but local depletion forms no part of the proper treatment of this affection, as it would only diminish the general strength without helping to remove the local disease.

General Suppuration will be considered when treating of Necrosis.

ABSORPTION OF BONE.

This may take place without any inflammation, and therefore without being accompanied by the formation of purulent matter, or of any secretion caused by inflammation. Of absorption of bone without inflammation there are two distinct varieties, namely, the continuous, and the interstitial.

Continuous absorption is the name given to that process by which a portion of bone is completely removed without inflammation. The condition under which this process takes place, is when a bone is subjected to gradual and moderate pressure, without the admission of the air to the compressed part. If there be admission of air to the compressed part, or if the pressure be very severe, inflammation will be induced, and purulent matter formed, and the process by which the bone is removed is then called ulceration. If the pressure be gradual and moderate, and if the air be excluded, the effect of the pressure is to stimu-

late absorption without inflammation, and the process by which the bone is removed is then called continuous absorption. By this process, in some instances, a large excavation is formed in a bone, and in others, the continuity of a bone is so interrupted that it becomes divided into two portions. Examples of this singular change are met with in cases of tumours, aneurism, or chronic abscess. The gradual compression caused by these diseases sometimes produces a depression in a bone, and in some instances, as for example in aneurism within the chest making its way to the surface, portions of some of the ribs are so completely removed that their continuity is entirely interrupted. The only mode of treatment which can stay the progress of continuous absorption, is to remove the exciting cause, by curing the disease from which it arises.

Interstitial absorption may affect either a part or the whole of a bone. In the former case it is indicated by dull uneasiness or a sense of fatigue, or aching of the part, increased very soon to actual pain on exercise; by slight oedema of the superimposed soft parts, which is also increased by exercise; by lividity from passive congestion, and sometimes also by coldness of the integument. This form of interstitial absorption often occurs in the tarsus and metatarsus, and in the carpus and metacarpus, and frequently terminates in caries. In this disease the laminated portion of a bone is converted into cancellated texture, and the walls of the cells become thinner, so that the cells appear very large. The surface of the bone also presents a very porous appearance. The treatment consists in attention to every measure likely to improve the general health, combined with rest of the part affected, and the constant use of gentle counter-irritation, while the symptoms continue. After the removal of the local symptoms, gentle support of the part is often found to be grateful to the feelings of the patient.

Interstitial absorption affecting the whole of a bone is often met with in diseases which affect the articular extremities of the long bones. There is a wasting and absorption of the bone as well as of the other tissues of the limb. To such an extent does this absorption sometimes take place that the shell of the bone becomes extremely thin, and the cancellated structure uncommonly open, so as to present the appearance of large cells with very thin walls, and in some parts the cancellated structure is entirely removed.

The removal of the local disease which is the exciting cause of this affection, and the improvement of the general health together with the restoration of the limb to the performance of its usual movements, are the only means by which the unnatural absorption can be checked, and the healthy communication of nutrition to the bone be restored.

ULCERATION OF BONE, OR THE SIMPLE AND TRACTABLE ULCER OF BONE.

Some writers use the terms ulceration and caries synonymously. By ulceration we mean that condition of bone in which there is loss of substance, together with suppuration, but in which the ulcer has a tendency to heal. In caries, on the contrary, while there is loss of substance, together with suppuration, there is so far from being any tendency to

heal, that healing is very difficult to accomplish. This difference as to the tendency to heal depends on the different conditions of the bone at the surface of the affected part. Mr. Liston observes, "It may tend to prevent confusion of the two different morbid states, if we confine the term ulceration to suppuration in and absorption of bone, whilst the vessels retain a considerable power of action, throw out new matter, and procure a reparation of the breach; and this condition of the osseous tissue exists when the disease is situated on the surface of the bone, and when it has been produced by an external cause. On the contrary, the term caries will denote that particular kind of ulceration in which reparation is hardly attempted by nature, and is with difficulty obtained by the most active interference; and this disease will be most generally found to affect the cancellated structure."

Ulceration is caused by pressure, combined with inflammation. In a portion of bone, excluded from the air, pressure alone, unless carried to such an extent as to excite inflammation, is not sufficient to produce ulceration, but may cause continuous absorption. Some writers therefore say, that pressure is the predisposing, and inflammation the exciting cause. Pressure may be either external or internal: examples of the latter are furnished by suppurative otitis taking place within a bone, when the matter may make its way to the surface by ulceration; and of the former many examples are met with, of which one of the most frequent is, pressure on the surface of the bone by collections of matter forming in consequence of inflammation of the superimposed soft tissues in the vicinity.

Ulceration of bone is characterized by an ulcer of healthy appearance. Examination with the probe is sufficient to show the nature of the disease. The bone itself, which supports the ulcerated portion, is not diseased, differing in this respect from the state of the bone in caries; for while there is in each disease the removal of part of a bone in consequence of inflammation, in a state of simple ulceration the portion of bone forming the surface of the part retains its natural compactness and firmness; but the portion forming the surface of a carious part, and to some depth below, is in a state of interstitial absorption. The action of the vessels is, consequently, very much weaker in the latter case than in the former, and hence arises the difference, as regards the tendency to heal, between the two diseases, which in other respects are very similar. Simple ulcer of bone is healed by the bone forming granulations, which, though soft at first, are soon converted by the deposition of earthy matter into bone. By these granulations the surface is to a certain extent elevated, and the edges of the ulcer are lowered by a process of absorption, so that the parts are brought nearly to a level with each other. Owing to the inelastic nature of the bone, the chasm cannot be diminished by the centripetal movement, as in an ulcer of the soft parts; but it is brought nearly to a level, as has just been described, by the rounding off by absorption of the edges, and the filling up of the centre by osseous granulations. The soft parts coalesce with the granulations, and a fibrous membrane is formed over the latter, on which a cicatrix, having a depressed, white, and firm appearance, is at last developed. This is the appearance of the cicatrix when the ulcer of the bone is perfectly healed, and the cicatrix adheres to the bone;

but occasionally a cicatrix is formed before the bone has healed, and then it does not adhere to the bone, but is elevated, livid, soft and painful, and is usually soon destroyed, exposing again the ulcer of the bone.

Treatment.—The constitutional treatment consists in the use of all prudent means for improving the general health, and maintaining the strength, so as to promote the energy of repair; and the local, in the removal of the exciting cause and the employment of rest, a proper attitude, simple water-dressings, or medicated, if it be necessary to stimulate, together with gentle support by bandages.

CARIES.

Caries is derived from *καίω*, to abrade, and is employed to denote a particular disease of bone. The terms, caries and necrosis, were by the older writers used indiscriminately, although they are two separate and distinct diseases. In caries, part of a bone is removed by the action of the absorbents causing a chasm; in necrosis, part of a bone completely dies; in caries there is very little, in necrosis a very great, effort of nature to form new bone.

"The points of resemblance," Professor Samuel Cooper writes, "between caries of bone and ulceration of the soft parts are striking; each affection is preceded by inflammation; each is attended with the formation of matter; each may be followed by the production of granulations; each may arise from local or constitutional causes; and each may be combined with the total extinction of vitality in certain points of the textures affected. Thus precisely in the same way as we often see ulceration and sloughing exhibited together in the soft parts, we also frequently find caries and necrosis prevailing together in the bones. Some portions of the osseous texture seem to perish and to be detached from the living parts of the bone, while in other places caries is making its attack and producing its usual effects." Caries generally affects the spongy extremities of the long bones, especially the ends of the femur and tibia, the bodies of the vertebræ, the bones of the tarsus and carpus, the sacrum, the sternum, the patella, the lower jaw, and occasionally the bones of the cranium. Necrosis, on the contrary, attacks the compact, lamellated or firm tissue of bone. Sometimes, though rarely, caries does present itself in the lamellated tissue of bone; but before this takes place the bone loses its compact appearance.

Causes.—These may be divided into external and internal. The principal external causes are a violent blow, or a wound, and more especially if it be combined with a bruise, as in a gun-shot wound affecting a bone, atmospheric changes, extensive injury of the periosteum, continued pressure by long maintenance of one position (as in a tedious illness, or fever, when caries of the sacrum is apt to take place, or of the trochanter major of the femur, or sometimes of both), suppuration or ulceration of the soft parts in the neighbourhood, or in short, any external injury or condition capable of exciting inflammation and ulceration of bone.

The principal internal causes are certain states of constitution, and more especially that condition which we denominate scrofulous, that which is the consequence of infection from the venereal poison, and that which results from the free or injudicious use of mercury. These conditions of system may be considered predisposing causes; but they seem also capable of acting both as predisposing and exciting causes; at all events, when any of them have produced the predisposition, caries makes its appearance from very slight external causes, and in many instances without any known exciting cause at all. The worst forms of caries are those which take place when all the above conditions meet

Fig. 90.



together; that is, in a scrofulous person infected with syphilis, whose constitution has been affected by mercury. Other internal causes, predisposing to caries, though not so powerfully, are the conditions of constitution which exist in scurvy, rheumatism, and gout. Scrofulous caries, syphilitic caries, scorbutic caries, rheumatic caries, and arthritic caries, are names by which some of the above-mentioned forms of this disease are distinguished. The various forms of caries differ from each other in the parts of bones in which they are most frequently found. Scrofulous caries, the most frequent form of all, usually attacks the spongy texture of bones, as the bodies of the vertebræ, the spongy extremities of the long bones, and the tarsal and carpal bones, beginning in these parts by the deposition of tubercular matter in their cancellated structure; which deposition is succeeded by inflammation, ending ultimately in caries. Syphilitic caries, which is the next in frequency, attacks the compact parts of the bony structure, such as the dense or hard part of the tibia, the compact part of the ulna, and the bones of the cranium. The rheumatic, like the scrofulous, is most frequently met with at the joint ends of the long bones; but it arises from inflammation of the ligaments and synovial membrane, extending sometimes to the articular surface itself. The arthritic, like the rheumatic, takes place in the region of the joints, but seems to prefer the external surface of the bone, and is generally preceded by a kind of exostosis in which the caries take place, and by the formation of arthritic concretions in the neighbourhood.

Phlegmonous erysipelas, suppression of customary discharges, and the sudden repelling of profuse eruptions of the skin, have been known to cause caries.

Fig. 90. Caries of bones of cranium and face, producing free communication between the mouth, nose, orbits, frontal sinuses, and cranium. Disease commenced by ulceration of soft palate with tubercular syphilitic eruption. From the history it appears that the patient had been subjected to the injudicious use of mercury. From a preparation in my museum.

Symptoms.—Caries being a result of inflammation, is preceded by ostitis, either acute or chronic, the symptoms of which will vary to a certain extent according to the nature of the ostitis, as will be readily understood from what has been previously stated regarding different varieties of inflammation of bone. Sooner or later the soft parts contiguous to the bone participate in the inflammation; and if the affected part be situated near the surface, a swelling is in some little time observable. This swelling is firmly adherent to the bone, and the skin over it becomes red, tense, and painful. It ultimately becomes soft, indicating the presence of suppuration; and if opened, or allowed to proceed without interference, the matter which escapes from it is thin and offensive, and rarely presents the characters of well-formed pus. After the discharge of the contents of the abscess, either spontaneously or by an opening, the cavity does not heal; but continues to discharge matter which tannishes a silver probe, is thin, ichorish, and offensive, and has that peculiar fœtor by which, without any other symptom, it is possible to determine with considerable certainty that it proceeds from a part connected with a diseased bone. The fœtid matter is loaded with a considerable quantity of phosphate of lime. The aperture of the abscess contracts and takes the form technically called fistula, and throws out from its edges granulations, which are spongy, painful, and very apt to bleed on being touched with the probe. The granulations project beyond the margin of the aperture, and the surrounding integument exhibits a livid hue. If a probe be introduced into the aperture, the bone is found to be rough and denuded, its surface irregular, and the osseous texture so much softened, that, with the slightest pressure, the probe will sink into it to a considerable distance. The impression communicated to the surgeon on making an examination with the probe, is not precisely the same in every instance of caries, the condition of the bones being different, as was before mentioned, in different forms of the disease. In caries of deep-seated bones, as for example, in scrofulous caries of the vertebræ, the accompanying collection of matter exhibits the characters of a chronic, instead of those of an acute abscess. I have often been struck, in cases of scrofulous caries of the vertebræ and of other bones, with the fact that in many instances, patients would scarcely admit that they had experienced any pain in any stage of the disease. The constitutional symptoms vary, in the first instance, according to the nature of the inflammation producing the caries, and the state of the patient's system at the time. In scrofulous caries the patient exhibits the strumous habit, and in general symptoms of scrofulous cachexy soon become very apparent. During the suppurative stage of caries, and more especially in cases where the caries communicates with an articulation, irritative fever comes on, but soon gives place to hectic fever, by which in unfavourable cases, such as when the caries is in inaccessible situations, the disease proves fatal. In some instances the only constitutional symptoms observable are those of hectic fever.

State of the Parts.—The bone does not in every instance of caries present the same appearance. If the varieties in the state of the bone be made the basis of arrangement, it may be said that caries may exist in one or other of the three following forms:—

1st. That in which there is a regular and distinct excavation of a portion of bone. The extent of the disease, however, is by no means indicated by the extent of the excavation.

2d. That in which the outer encasement or lamella of bone gives way, and the cancellated structure becomes carious without any distinct excavation. In this form the destruction by ulceration is very superficial, being confined to the outer encasement, but the alteration by interstitial absorption in the cancellated structure is very extensive.

3d. That in which the bone has the appearance of having been perforated in innumerable places, termed the worm-eaten caries. This condition is occasionally met with in the external surface of a long bone affected with the first form of caries, the perforations being found in the outer encasement in the neighbourhood of the excavation; but the best examples of worm-eaten caries I have seen, have been in the cranium. In one admirable preparation of this form in my possession, the whole of the upper part of the cranium is occupied with innumerable perforations, and in another, the bones are in some parts bored in hundreds of places, and in others, affected with necrosis. In the first mentioned specimen the bones have in every respect, with the exception of the perforations, a healthy appearance, no traces whatever being observable of any other disease, or of any deviation from the natural and sound condition of the osseous structure. In some other specimens of this form of caries, I have been struck with the absence of any apparent traces of change of structure in the osseous substance, a circumstance in which this form seems occasionally to differ from the other two varieties. In the second specimen mentioned above, the disease was in a girl twelve years of age, and was occasioned by a blow.

In the first form of caries there may be said to be three different states. First, a part of the bone, where the excavation exists, is removed by ulceration. Second, the part which forms the surface of the carious portion is affected to a considerable depth by interstitial absorption, in consequence of which its lamellæ are so thin, and its circulation so feeble, that a healthy action rarely takes place. Its circulation is sufficiently weakened to create a great obstacle to the formation of healthy granulations, and yet not so as generally to deprive the part of all vitality and produce necrosis. It is in the presence of this interstitial absorption, that caries differs from simple ulceration. Third, beyond the interstitially absorbed part, the bone is often rendered preternaturally dense by the secretion of new osseous matter into its cancellated structure; and its external surface is, from the same action, covered over with nodules or spicula of new bone at the parts where

Fig. 91.



there is a sound and firm bone underneath. In the second form the ulceration is very superficial, but the interstitial absorption very deep and extensive, and sometimes, as some specimens of it in the tarsal bones in my own collection demonstrate, it extends almost through the whole of the bone. When it is very extensive, the attempts at the formation of new bone in the neighbourhood of the interstitially absorbed part are very feeble, and in many instances, no traces whatever of such an action can be discovered. Although the interstitial absorption frequently extends to a great depth, it is also certain, on the other hand, that occasionally it is very superficial, and the very limited extent of change of structure is sometimes remarkably disproportioned to the severity and obstinacy of the symptoms. Caries is in every instance a consequence of inflammation, and it may or may not be accompanied by the deposition of tubercular matter in the cancellated structure. When there is a deposit, it may present any of the varieties of appearance mentioned in the section on suppuration of bone, and, as is there stated, it may not be a product of inflammation, but a consequence of previous perversion of nutrition in a person of a scrofulous constitution. In some instances this deposit is limited to a small part, in others it is very diffused; in some it is contained in cells of the cancellated structure, and in others, as many of my own preparations evidence, it seems to occupy the whole space included within the shell of the bone, and scarcely any traces of the cancellated structure remain. When the deposit is present, the attempts to secrete new bone in the neighbourhood of the part involved in the caries seem to be in general extremely feeble, and such cases are in consequence exceedingly unpromising. Professor Syme remarks, that after maceration a carious bone looks as if it had been burned, being harder, whiter, and more brittle than natural. I have sometimes been struck with this brittleness and hardness after long maceration and drying in instances where, while the bone remained in the body, it felt so extremely soft, that a probe could with the slightest pressure, and almost without experiencing any resistance, be made to sink through it in any direction.

DIFFERENT MODES OF SPONTANEOUS CURE.

Nature sometimes accomplishes a cure of caries in one or other of the three following ways:—

1st. By a complete change in the action of the diseased part, in consequence of which granulations form, which are converted into bone; and a deposit of osseous matter thus taking place, the cavity is filled up in the same manner as a simple ulcer of bone.

2d. By a process of exfoliation, by which the whole of the ulcerated portion of bone is thrown off, together with the parts rendered weak by interstitial absorption.

3d. By ankylosis, or that process in which sufficient new callus or bone is thrown out to ossify the articulation.

Treatment.—In all inflammations of bone, such treatment should be adopted, as will be most likely to prevent them from terminating in caries. With this view local and general depletion, though necessary, must not be carried too far, as the consequent debility predisposes to

caries ; and as the danger of its occurrence is likewise increased by the interstitial absorption arising from the free use of mercury, this medicine, if ventured upon at all, must be exhibited with great caution. Simple ulceration of the bone should be healed as speedily as possible ; unnecessary irritants should never be employed ; abscesses must be opened, and "effused pus ought never to be allowed to remain on the surface of the bone, but must be early evacuated." If caries be the consequence of scrofula or syphilis, it is not so much under the influence of local treatment as of the proper constitutional treatment for those diseases.

When caries is fairly established, the treatment varies according to the situation of the disease. On this account, the situations of caries are divided into those accessible, and those inaccessible, to the surgeon. To the latter class belong caries of the vertebræ, of the hip-joint, and of the knee.

In accessible caries, unless there be great reason to hope for a spontaneous cure by one or other of the three processes already described, the best treatment is the complete removal or excision of the diseased portion of bone. On no account, however, should any attempt at removal be made, while acute inflammation exists in the bone or the neighbouring tissues. Although the carious part could be excised under such circumstance, the operation, instead of being succeeded by a healing process, would, by increasing the inflammation, cause extension of the disease. With regard to the extent of removal, suffice it to say, that a firm, sound base should be left ; the whole of the ulcerated and interstitially absorbed portion of bone should be removed. The instruments most serviceable for the excision or removal of the diseased part vary according to the situation. In some instances, a scoop may be sufficient ; in others, trephines, saws, knives, or the cutting forceps, are required. After removal has been effected, the wound should be treated in the manner proper for a simple ulcer of bone. If the caries has been in parts which form an articulation, the bones must, after the operation, be kept in apposition, and at perfect rest. It sometimes happens that a patient cannot be persuaded to submit to the operation of excision. Under such circumstances, the most advisable procedure is to destroy the diseased part by means of the chloride of zinc, made into a paste, or the red oxide of mercury in powder. For my own part, I prefer the former escharotic, but they both answer very well, and are not, like acids or liquid escharotics, liable to the objection of sinking deep into the substance of the bone, and thereby causing extensive and unnecessary destruction, or of increasing the disease. The escharotic must be employed so as to insure the object of its application, namely, the complete destruction of the diseased part ; and after it is taken off, some lint should be introduced into the wound, and poultices employed for alleviating the pain, and promoting the separation of the destroyed parts. When removal has taken place, the treatment proper for a simple ulcer of bone should be adopted. It sometimes happens, that after the surgeon has removed, by instruments, as much of the bone as seems advisable, a part still remains of a suspicious appearance, yet not so circumstanced that it would be judicious to remove it by excision.

Some surgeons recommend that, in such circumstances, the suspected part should be destroyed by one of the escharotics above mentioned; and the practice is often followed by the most satisfactory results. At one time the actual cautery was much employed for the destruction of carious parts. In regard to this practice I cannot do better than quote the language of Mr. Liston. "The application of the actual cautery may be by some considered necessary; at one time I employed this remedy very extensively in caries, and occasionally with very good success. I have since, however, been led to change my opinion, and am now inclined to prefer the potential cautery. By the application of the red-hot iron, the diseased portion is destroyed effectually, but at the same time, the vitality of the surrounding parts is often very much weakened, and their power of reparation diminished, so that they are incapable of assuming a sufficient degree of action for throwing off the dead part; their action being increased, while their power is diminished, they may become affected with caries, and thus, instead of being arrested, the original disease will either be increased, or extensive necrosis may take place."

When the caries is in situations inaccessible to the surgeon, that is to say, where it does not admit of excision, as in the hip-joint, the knee-joint, and the vertebræ, the surgeon should endeavour to obtain ankylosis. The most important means for this end are,—attention to every measure, judicious in the condition of the patient, for maintaining the general health and strength, perfect rest of the affected parts, and the employment of counter-irritation. If the vertebræ be the subject of the disease, the spine must be kept at rest, and in a reclining position, so as to remove from it the superincumbent weight. The treatment, however, of caries in that situation will be particularly described in the section on diseases of the spine. If the knee-joint be the part affected, the limb ought to be extended, and kept in that attitude by means of a flat concave splint, applied behind the joint; if the disease be in the hip-joint, the trunk, thigh, and leg ought to be preserved in a straight line with each other. Counter-irritants are also used with advantage. Those which are most generally preferred, and which are found to prove most beneficial, are blisters, small issues kept open by the occasional application of potassa fusa, and setons. Experience seems to show that, in some situations, some of the means for producing counter-irritation are employed with more advantage than others; but this will be more fully explained in the description of the diseases of the joints and of the spine. One important point, however, should always be kept in view, whatever be the application employed; and that is, not to produce such a discharge as would affect the general strength; for the maintenance of the patient's general health is fully as important as keeping up counter-irritation. When a collection of pus is perceptible, it must be opened by a small orifice in the most dependent part, and gentle pressure employed to keep the sides of the abscess in apposition.

NECROSIS.

This term, derived from *νεκρῶσις*, to put to death, is now, by the consent of surgeons, employed to denote the dead condition of bone. In the soft tissues the state corresponding to necrosis, is called mortification.

Louis, who was the first to restrict the application of the term necrosis to death of bone, applied it only to death of the entire thickness of the bone, and not of the external or internal part, of which, however, there is frequently complete death, followed by removal. The bones most liable to necrosis are, the tibia, the femur, the lower jaw, the clavicle, the fibula, the humerus, the radius, and the ulna; occasionally, also, the bones of the cranium are subject to it. While caries, as has been already noticed, is found principally to affect the spongy portions of bone, necrosis, for the most part, attacks those bones which are of a firm, compact texture. It may occur at any period of life, and in both sexes, yet we more commonly meet with it in young persons from twelve to eighteen years of age; but when it affects the lower jaw, it is seldom before the thirtieth year.

The *causes* of necrosis may be divided into external and internal. Of the former are severe contusions of bone; bad compound fractures; the pressure and irritation of tumours, of abscesses, or of a musket ball; acute osteitis; or the application of strong concentrated acids. It frequently results also from severe cold, and occasionally from burns. Destruction of the medullary membrane is found, by experiment on the lower animals, to produce necrosis. The internal causes are such as affect the bone through the medium of the constitution. Scrofula, syphilis, and the baneful influence of mercury on the constitution, seem to produce a considerable tendency to necrosis.

If necrosis take place without any known exciting cause, it is said to be idiopathic; if it be the consequence of a compound fracture, it is called compound; if it be caused by violence, as by a blow, it is denominated traumatic.

Varieties of Necrosis.—The different forms or varieties of necrosis are by some arranged into two, by others into three, separate and distinct species. We shall, however, consider four varieties.

1. That form which generally occurs in a person of a scrofulous habit of body, and in which the short bones are affected, as those of the tarsus, metatarsus, carpus, or metacarpus.

2. That form in which there is death only of the outer lamella, that is, in which the disease is superficial, and does not extend through the whole thickness of the shell of the bone. This form sometimes presents itself in the flat bones, as the scapula, and the bones of the cranium.

3. That form which destroys the internal part of a bone, and in which the cortex or outer shell is not affected. This is by some writers called internal necrosis.

4. That form, in which the whole thickness of a bone perishes. The three last-mentioned forms may be distinguished from each other by the names of external, internal, and general necrosis.

Symptoms of the First Form.—An indolent swelling first presents itself, unattended with much pain or constitutional disturbance. The swelling is at first hard, after some time oedematous, and at length attended with fluctuation in consequence of a thin ichorish fluid collected in the part. If a probe be introduced, the bone will be felt to be rough, and divested of its periosteum. The aperture has little tendency to heal. In consequence of the continued irritation, hectic fever is pro-

duced. As in this form nature makes no attempt at reproduction, removal of the limb is absolutely necessary.

Symptoms of the Second Form.—These, in the first instance, depend upon the cause of the disease, which is often an acute abscess, or acute periostitis, or acute osteitis. A small abscess occurs in the soft parts, which, if left to nature, discharges itself. If a probe be introduced, the bone is found to be bare, and a part perhaps loose. The aperture does not heal until the sequestrum or dead portion of the bone is removed, but becomes what is technically called a fistula. The separation of the sequestrum is effected by the absorbents taking up the next layer of bone, and bears an analogy to that process by which sloughs of the soft parts are detached. The aperture now heals by granulation in the same manner as in simple ulcer of bone. This form of necrosis has by some writers been called exfoliation.

Symptoms of the Third Form.—There is most excruciating pain, supposed to arise from the resistance offered by the cortex or outer lamella to the swelling of the inflamed part. The inflammatory fever is often so high as to prevent the patient from obtaining repose. The swelling is exceedingly hard and diffused, depending on the swollen condition of the bone. It also continues for a very long time, before anything unnatural is observed in the soft parts; but in them an abscess gradually forms. The pain is not aggravated, as in other forms of this disease, by pressure or handling of the limb. The other symptoms nearly correspond with those of general necrosis.

Symptoms of the Fourth Form.—In this form of the disease the articulatory extremities are not generally involved. Pain of a most excruciating, girding, bursting character is one of the earliest symptoms. The pain is constant, and is followed by a swelling, which is diffused, presenting no distinct bounds, but generally greater about the middle of the limb than elsewhere. The character of the swelling at first is doughy and elastic, by reason of the effusion between the periosteum and the bone, and the thickening of the periosteum itself. This is followed by a soft swelling, which is less diffused, and ultimately attended with fluctuation, and presents the ordinary local symptoms of an acute abscess, which, if permitted, finds an outlet for itself. If a probe be introduced after the contents of the abscess are discharged, the bone will be found to be bare, and ultimately becomes loose. The pus itself is thick, yellow, and of a healthy, purulent character. After the evacuation of the abscess, there is some diminution of the pain; but the opening has no disposition to heal, and presents the appearance which is technically called fistula. After the matter is discharged, there is but little subsidence of the swelling, which is general, presenting no distinct boundary, and of a firm, unyielding kind, depending at this advanced stage on the deposition of new bone, and certain conditions connected with that process.

Constitutional Symptoms.—Violent inflammatory irritative fever attends the first stages of necrosis. If the constitution be good, and not reduced by long-continued and extensive suppuration, hectic fever may not come on; but there is much reason to apprehend it, if the constitution be feeble, or the disease very extensive, or the articulations affected.

Sequestrum.—The sequestrum, or dead portion of bone, is always of an ivory-white appearance, except when it is exposed to the atmosphere through the soft parts, or is situated at the bottom of a large ulcer: it is then of a dark brown, or even black colour, in consequence of the action of the air. In general necrosis, that is, when the whole thickness of the shaft perishes, the sequestrum is situated within the newly-deposited bone; in other words, the new bone surrounds or embraces the sequestrum, which is observed to be somewhat reduced in size, in comparison with the original bone. Some authorities suppose, that the absorbents have the power of removing a portion of the sequestrum, into the system. Mr. John Hunter, Sir W. Blizard, and Professor Russell of Edinburgh, held this opinion; as do also Mr. Lawrence of London, and M. Velpeau of Paris.

Messrs. Gulliver, Stanley, and Liston, maintain, that the sequestrum cannot be acted on by the absorbents. Mr. Liston observes, "But a dead portion of bone detached from the surrounding parts, is in every respect an extraneous body, and is not and cannot be, acted on by the absorbents any more than a piece of metal, wood, or stone. Some have gone so far as to affirm that portions of foreign bodies, ligatures, &c., are absorbed, but this opinion is altogether too absurd to require any contradiction; the knots of ligatures, like portions of glass or other foreign substance, become surrounded with a dense cyst, and often remain in the body for a long time; so do portions of dead bone, separated by the process here described. A series of experiments were made by Mr. Gulliver, in order to put this question at rest, many of which I witnessed and assisted at, and several also I repeated. Setons of bone were inserted, and worn for a long time; thin plates of bone were confined on suppurating surfaces, pieces of bone were inserted in the medullary canal of various animals, and kept there for months, and in one instance for more than a year. These foreign bodies were weighed with the greatest care and accuracy before and after they were so exposed, and were found unaltered in any respect." That the sequestrum is often much less than the original bone, is a fact which is beyond all doubt; but absorption does not, and cannot take place, except through the medium of the vessels of the sequestrum, before it has lost all its vitality.

Separation.—Respecting the process by which the dead portion of bone is separated from the living, the older writers had very vague ideas. Hippocrates stated that separation was accomplished by fleshy granulations. Some supposed that it was effected by the pulsation,

Fig. 92.



Fig. 92. Drawing of a preparation in my own collection.

others by the distension of the vessels of the parts ; and Mr. Benjamin Bell thought that the dead bone was separated by suppuration and granulation. The investigations of Wiedmann have set this question at rest. "The parts surrounding the dead portion directly become preternaturally vascular. A groove is next formed all round the sequestrum, which is generally believed to be produced by the action of the absorbents of the adjoining living bone, or, as Mr. Hunter first demonstrated, the groove is formed by the absorption of that part of the living bone which is contiguous to the dead ; its earthy matter being first taken away, and then its animal part, the groove begins on the surface, and extends gradually more and more deeply, until the dead portion is completely undermined and detached."

Reproduction.—The power of reproduction varies much in the different bones of the body, being great in some, and less in others, while there are those in which it is not at all manifested. It is, of course, much greater in young healthy subjects, than in old debilitated persons. Though the long bones, the lower jaw, the clavicle, and the scapula possess the power of reproduction, to a very considerable extent, the short cuboid bones cannot be reproduced. A case is related by Wiedmann, in which nature effected reproduction of nearly the whole of the lower jaw ; and one by Chopart, in which the clavicle was reproduced. An instance is also on record, of the reproduction of nearly the whole of the scapula. Portions of the cranium under particular circumstances may, to a certain extent, be reproduced ; but if both the tables of the cranium be destroyed, together with the pericranium, there will be very slight reproduction ; for the dura mater has very little tendency to form new bone. This is the reason why, after the operation of trephining, the pericranium and both tables of the skull being removed, reproduction does not take place to any great extent.

From what source is the New Bone derived ?—This is indeed a "questio vexata." Different pathologists give different answers to the following questions, Whether Nature, for the accomplishment of her purpose, employs the vessels of the periosteum—or those of the medullary membrane—or those of the old bone itself ? It seems clear that in external necrosis, new granulations spring up from the living bone, and reproduction is effected in the same manner as in simple ulcer of bone. In internal necrosis, it is supposed that the living cortex or outer lamella of the bone, which becomes preternaturally vascular, swollen, and softened, is the source of the new bone. That it cannot be by the vessels of the medullary membrane, is manifest from observation ; for in this form of necrosis the medullary membrane is completely destroyed. In general necrosis, or those cases



Fig. 98. Entire regeneration of Tibia. Drawn from a preparation in my own collection.

in which the entire thickness of a bone, and the medullary membrane perish, it is believed that the new bone is derived from the periosteum of the old bone. Duhamel first mooted this opinion, which Troja afterwards supported. Troja produced necrosis by passing a red-hot iron into the medullary canal of various animals, and he ascertained that, when a portion of bone is about to perish, the periosteum becomes detached and raised up from the bone, and the space is occupied by purulent matter. Dr. Macartney had an opportunity of witnessing this separation of the periosteum from the bone in the human body, in consequence of destruction of a small portion of the medullary membrane by disease. The periosteum becomes very vascular, and thereby is rendered soft, pulpy, villous, and perfectly red on the surface in contact with the bone, the cellular tissue external to it also becoming swollen. The central part of the periosteum is next converted into cartilage, and afterwards into bone, so that the new bone is formed in the centre of the periosteum. "Some pathologists deny the ossific power of the periosteum, and claim the whole production of new osseous substance for the bone itself. That the process of reproduction may be accomplished in this way, I am not prepared to deny, but that it is not necessarily or always so performed, will I think appear from the following case :—"A girl, twelve years of age, strained her ankle, in the month of March, 1835. Inflammation followed, extending up to the knee, and attended with violent fever. She was brought to the hospital, and placed under my care. Incisions were soon afterwards made to evacuate a large collection of matter, which had formed in the leg ; and the bone being found dead, while the patient's strength was rapidly going away, I amputated the limb above the knee, five weeks after the injury had been received. The girl recovered and is now well. In examining the limb to ascertain the extent to which the bone had died, I found that it was partially surrounded by the commencement of a new one. The shell had already acquired considerable firmness at some parts, but was not equally thick throughout, and did not seem fixed to the ends of the old shaft. This observation led to a very careful dissection of the parts concerned : and they are now before the Society. It will be seen that the tibia had died very nearly from end to end, and that the new shell enclosing it had been formed in the periosteum. The new osseous substance may be observed at some parts, in the form of distinct scales. At other parts it looked as if it had originally consisted of separate portions, and been composed by their union. The periosteum connecting these portions to each other, and to the extremities of the bone, was not thickened beyond its natural condition, and where it covered the posterior surface of the tibia, though quite detached from the old bone, had not suffered any further change. There is here then an instance of a bone dying suddenly in consequence of acute inflammation, without any thickening being previously found in its neighbourhood, and nevertheless succeeded by the production of a new osseous shell, which evidently could not proceed from the old bone, and no less evidently depended on an ossific process resident in the periosteum. As Nature is not capricious or variable in her proceedings, I regard this case as sufficient of itself, without any further evidence, to establish the ossific power of the

periosteum. But with the view of making the matter still more clear, I performed the following experiments. I exposed the radius of a dog, and removed an inch and three-quarters of it, together with the periosteum. At the same time I exposed the radius of the other leg, and removed a corresponding portion *without* the periosteum, which was carefully detached from it, and left quite entire, except where slit open in front. Six weeks afterwards the dog was killed, and the bones examined. In the one from which a portion had been taken, together with the periosteum, the extremities were found extended towards each other in a conical form, with a great deficiency of bone between them, and in its place merely a small band of tough ligamentous texture. In the other, where the periosteum had been allowed to remain, there was a compact mass of bone not only occupying the space left by the portion removed, but rather exceeding it in thickness. This experiment, when repeated, afforded the same results.

"I next exposed the radius of another dog, and separated the periosteum from the bone, as in the former experiment; but then instead of cutting out the denuded bone, inserted a thin plate of metal between it and the periosteum. The edges of the membrane, and then those of the skin were sewed together, and the wound healed kindly. At the end of six weeks, I dissected the limb, and found a deposition of osseous substance in the periosteum, forming a bony plate exterior to the metal, and not connected to the old bone, except by the membrane. I lastly exposed the radius of a dog, and cut away the periosteum to the same extent that it had been detached in the experiment just mentioned, and surrounded the denuded bone with a piece of metal. At the end of six weeks I found a thick tough capsule formed, enclosing the metallic plate, but having no osseous substance in it. The evidence which has now been adduced seems to me sufficient for putting beyond all question the power of the periosteum to form new bone, independently of any assistance from the old one."—Syme's "Principles of Surgery," pp. 191-3.

From the case and experiments published by Professor Syme, it seems warrantable to conclude, that the new bone is formed within the centre of the old periosteum, which first undergoes the various preparatory changes already described. The observations of many other authorities have led them to the same conclusion; and I have for years exhibited to the Class of Surgery in Marischal College, a beautiful preparation, still in my possession, which most clearly demonstrates the vascularity of the inner surface of the periosteum, the deposition of ossific matter within its centre, and the perfect continuity of the altered portion, in which is contained the new bone, with the periosteum of the neighbouring portions of bone which are not involved in the disease.

Such seems to be the correct doctrine regarding the source of new bone in general necrosis; but there are some who embrace this opinion only in part. They agree that the new bone is derived from the periosteum as its source, but consider that it is not developed in the centre, but formed on its inner surface; and affirm that a secretion of lymph takes place between the inner surface of the periosteum and the bone, "which undergoes the preparatory change into a gelatinous or cartila-

ginous tissue previous to its ossification." If this opinion be correct, it is difficult to explain the vascularity of the interior of the new bone.

Dr. Macartney believes that the new bone is formed from the periosteum, but seems to think that it is not developed in its centre, as the experiments and case of Professor Syme, and the preparation in my own museum tend to prove, but formed on its inner surface; and he describes the original periosteum as disappearing, not as becoming afterwards attached to the new bone. He remarks that "the first and most important circumstance is the change which takes place in the organization of the periosteum; this membrane acquires the highest degree of vascularity, becomes considerably thickened, soft, spongy, and loosely adherent to the bone. The cellular substance also, which is immediately connected with the periosteum, suffers a similar alteration; it puts on the appearance of being inflamed, its vessels enlarged, lymph is shed into its interstices, and it becomes consolidated with the periosteum. These changes are preparatory to the absorption of the old bone, and the secretion of the new osseous matter, and even previous to the death of the bone which is to be removed. In one instance I found the periosteum vascular and pulpy, when the only affection was a small abscess of the medulla, the bone still retaining its connexion with the neighbouring parts, as it readily received injection. The newly organized periosteum, &c., separates entirely from the bone, after which it begins to remove the latter by absorption; and while this is going on, its inner surface becomes covered with little eminences resembling granulations. In proportion as the old bone is removed, new osseous matter is dispersed in the substance of the granulations, while they continue to grow on the old bone, until the whole or a part of it is completely absorbed, according to the circumstances of the case. What remains of the investment after the absorption of the old bone and the formation of the osseous tube which is to replace it, degenerates, loses its vascularity, and appears like a lacerated membrane. I have never had an opportunity of examining a limb, a sufficient time after the termination of the disease, to ascertain whether the investment be at last totally absorbed; but in some instances I have seen very little remaining. During the progress of the disease the thickened cellular substance which surrounded the original periosteum, becomes gradually thinner, its vessels diminish, and it adheres strictly to the new-formed bone, to which it ultimately serves as a periosteum." I have introduced the above extract because it well describes some points, and gives a distinct account of the writer's views; but from what has been previously stated, it will be seen that I follow the authorities whose views do not altogether coincide with these. Mr. Stanley is of opinion that when necrosis is attended with destruction of the bone and of the medullary membrane, the bone may be regenerated from three sources, namely, from the periosteum which invested the old bone, or from the articular ends of the old bone; or, if the periosteum be destroyed, from the soft parts which surrounded it. He states that he destroyed the medullary membrane in a dog's tibia, and removed the periosteum, and yet reproduction ensued from the vessels of the surrounding cellular tissue, which became exceedingly condensed, so as to form a periosteum. The results of some of the ex-

periments of Dupuytren, Breschet, and Villermé, on the formation of callus, in some respects agree with the evidence furnished by the experiment of Mr. Stanley.

Fig. 94.



Cloacæ.—In the sides of the newly-formed bone are observed a number of foramina, called by Wiedmann, *Cloacæ*, and by Troja, *foramina grandia*, which serve as an outlet for the extraction of the sequestrum, provided it be not too large, and for the escape of the purulent matter confined within the cavity of the bone. The *cloacæ* generally present themselves in the middle or under third of the bone, and are usually of an oval shape, and oblique in their direction. Mr. Davies, and some others suppose that the *cloacæ* are formed by the matter secreted in the interior of the new bone, which, from its great quantity distends, and ultimately bursts the periosteum, thereby giving rise to these apertures. According to Wiedmann, this doctrine is incorrect, for *cloacæ* are observed in situations where matter does not exist. Others attribute their formation to the corrosive qualities of the pus; but it seems more probable that they are occasioned by the non-deposition of osseous matter, at certain parts in the centre of the periosteum. In some preparations, the parts where bone has not been deposited, are filled up by periosteum. In a preparation in my collection, there are several *cloacæ* filled up by periosteum, which is evidently continuous with that which covers in, and that which lines the outer and inner surfaces of the neighbouring portions of new bone, these portions being clearly deposited in the

centre of the periosteum.

After the entire removal of the sequestrum, the new bone gradually becomes consolidated and smooth on the surface, by the action of the absorbents, and is lined by a medullary membrane.

Treatment.—Preventive treatment should be first employed with an activity commensurate with the severity of the symptoms, and the strength of the patient. If the osteitis proceed from syphilis or scrofula, in addition to other remedies, the preparations of iodine, especially the iodide of potassium, with sarsaparilla, will be found valuable. As soon as the existence of purulent matter is detected, free direct incision should be made; which will save much time, alleviate suffering, spare the strength of the patient, and circumscribe the extent of the disease. If hectic fever supervene, the strength of the patient must be supported by means of tonics, pure air, and suitable diet and regimen, until the process of separation be completed. In fact, the duty of the surgeon during the process of separation, which is a work of nature, is to keep the limb in a quiescent state, and to combat all untoward symptoms as they may arise.

The Process of Extrusion.—The efforts of nature in this process being feeble, the surgeon ought to interfere, and afford the necessary

Fig. 94. Drawn from a preparation in my own collection.

assistance for the removal of the necrosed part. The proper period for this interference is, when the sequestrum has been separated from the living portion; but first, the surgeon should consider the course of the cloacæ, and endeavour to form some opinion of the size of the sequestrum; then he should make a free direct incision, generally longitudinal in its direction, not too long, as there is danger of hemorrhage, nor too short, as the difficulty of extraction would be thereby increased, and the operation rendered unnecessarily tedious. When the sequestrum is loose, it may easily be removed by a pair of forceps, if the cloacæ be sufficiently large. Sometimes it is necessary to cut a portion of the new bone which confines the sequestrum, or to divide the sequestrum itself by Liston's forceps, or Hey's saw, or some other convenient instrument. "The instruments," Mr. Liston observes, "and especially those for extraction, ought to be very powerful and suited to the purpose; for in the employment of inefficient means there is much folly and cruelty." After the operation, which is generally attended with a profuse hemorrhage, the wound should be filled with lint, and the limb placed in an elevated position. Antiphlogistic means may be necessary to prevent osteitis.

There are certain unfavourable cases of necrosis in which amputation is not only warrantable, but indispensable. If the hectic fever, caused by the long-continued suppuration, threaten to prove fatal; or if the neighbouring articulations become involved in the disease, amputation is the only possible means of saving the patient's life. The bones of the tarsus and carpus, as was previously stated, are never reproduced; and sometimes, in very weak, debilitated persons, there is no reproduction in the long cylindrical bones. In these cases, also, amputation is admissible. "The treatment," Mr. Liston says, "may be summed up in a very few words. Prevent the necrosis, if possible, open abscesses whenever they appear, encourage the patient to move the neighbouring joints, support the strength, remove sequestra when loose, but do not interfere until they are ascertained to be so, give the limb proper support, and rest when a large sequestrum is formed. When fracture has taken place, when the health has been undermined, or when neighbouring joints have become diseased, amputate in order to save the life, if it be impossible to save the limb."

RICKETS.

The spine was by the Greeks called *ῥαχίς*, from which is formed *rachitis*, strictly meaning, disease of the spine; and from *rachitis* is derived the English word *rickets*. The terms *rachitis*, and *rickets*, are not, however, used to denote a disease of the spine, but one in which there is a preternatural softness of the osseous system, affecting the spine in common with other parts; and these names were originally applied to the disease from an erroneous impression which at one time prevailed, that it originated in the vertebral column. It is a remarkable fact, that this disease appears to have almost escaped observation until the middle of the seventeenth century, there being no distinct account of it given by the ancients, nor by any author of the middle ages. It was first described by David Whisler, in a tract published in 1645, en-

titled, "De Morbo Puerili Anglorum dicto The Rickets;" but it was more fully described in 1671, by Glisson, in his treatise, "De Rachitide, Sive Morbo Puerili." The last-mentioned author states, that it first appeared in England in the middle of the seventeenth century, since which time it has been a well-known disease in these islands, and in many other parts of Europe. It can scarcely, however, be supposed that the disease did not exist previous to the above period, but merely that it escaped particular observation. Dr. Craigie remarks, "Its occurrence in infancy only was the cause of its escaping observation; its influence, however, in leaving more or less deformity of the skeleton, must have at all times attracted notice. Deformed dwarfs have been known in all ages; the *gibbi*, the *vari*, and the *valgi* of the Romans must have been more or less rachitic in their infancy. From this cause the deformity of Thersites might have originated. It is also to be remarked, that Fabricius Hildanus delineates the serpentine lateral curvature of the spine in a girl of eight, whose bones were soft as wax, which could be produced by no other cause save rickety softness."

Symptoms.—This disease generally attacks children between six months and three years of age; but it is often known to occur at an earlier period, and a few instances are recorded of its taking place in the fœtus. Pinel describes the skeleton of a rickety fœtus. University College Museum contains a splendid specimen which I have examined; and Sœmmering, Bordenan, Loder, and others testify to the fact that the disease is sometimes met with affecting the bones of the fœtus. From a state of apparent vigour the child begins gradually to decline in health, and to lose his liveliness; the muscles diminish in size and become loose and flabby, causing that diminished appearance of the extremities and neck, which contrasts strangely with enlargements perceptible in other parts of the body. In the progress of the disease there is much general weakness; the skin loses its elasticity and becomes pale, and, in aggravated cases, of a dusky appearance; the digestion is often impaired; the breath has a sour smell, and the abdomen becomes enlarged, and has to the touch a doughy feeling: this enlargement, for the most part, arises from distension of the intestines with gas. It has sometimes been believed to be produced by disease of the spleen, or of the liver, and more especially of the mesenteric glands. There can be no doubt that in patients affected with rickets, these organs are often found diseased; nor is this at all surprising; but that such disease forms no essential part of the state of the body in rickets, is evident from the fact that, in many instances, there is found no diseased condition of any internal parts except the bones. There is softness of the bones from the interruption of the ossific process; and becoming, in consequence of this softness, flexible and incapable of offering resistance, they yield to the superincumbent weight and to the action of the muscles; and hence result various unnatural conditions observable in the extremities, the spine, the chest, the pelvis, and the head.

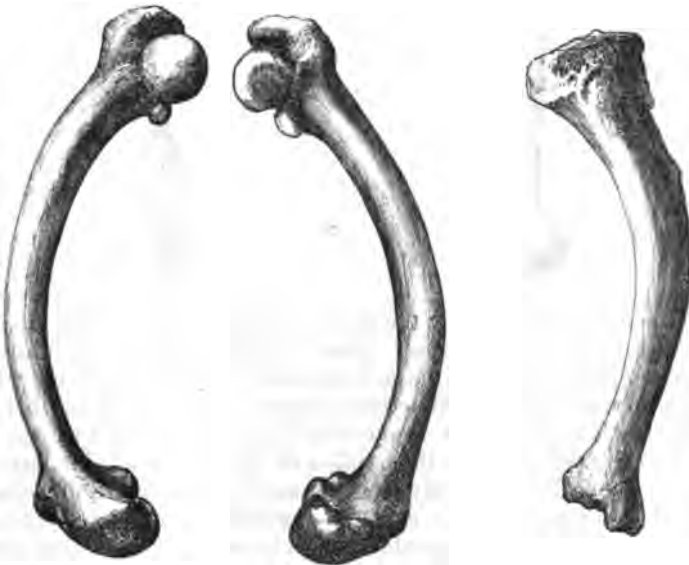
The upper and lower extremities frequently exhibit a remarkable contrast of appearance; the former, from not having to support any weight, are in general proportionate and free from curvature, while the latter are bent so as to become much shorter than natural. The bones give

way principally from the effect of the superincumbent weight, and partly also from the effect of the muscles. The form which they assume in the limbs is generally an exaggeration of the natural configuration; by which I mean, an unnatural degree of the curvature proper to the bones. The lower limbs exhibit great varieties of deformity; they are often bent laterally by the action of the muscles, and in such cases they are always bent to the side on which the muscles act most powerfully. The femur may be bent forwards, or laterally, or forwards and outwards; the tibia may exhibit a curvature forwards; or the knees may both fall inwards with the feet thrown outwards; or both the extremities may be together thrown to one side, forming a curvature of the whole length of the extremities with the greatest convexity at the knees, and directed to one side and the concavity to the other. Although, as it has been already stated, the bones of the upper extremities are more rarely

Fig. 95.

Fig. 96.

Fig. 97.



affected than those of the lower, yet they do sometimes suffer to a certain degree both as to length and size. The clavicle may be bent unnaturally forwards, partly by the weight of the shoulder, and partly by the action of muscles going from the front of the chest to the bones of the extremity; and the humerus, radius, and ulna may also become bent in directions determined by the actions of the muscles. The spine exhibits in a marked degree the effects of rickets, the weight of the head, and other superincumbent parts, bending it in various directions; and with distortion of the spine is usually associated deformity of the chest, which is sometimes flattened laterally by the ribs falling in on both sides, in which state the sternum is pushed forwards, and the front of the chest

Figs. 95-97. From preparations in my own museum.

acquires somewhat of the form of that cavity in a bird, and hence the expression "chicken breasted" has been used to describe that peculiarity of form. The chest, in these cases, may be flattened on one side, and rendered very convex on the other, as in lateral curvatures of the spine from other causes. The chest is shortened on the flattened side, and the intercostal spaces very much diminished from above downwards;

Fig. 98.



Fig. 99.



whereas, on the convex side, the chest is lengthened, and the intercostal spaces are larger than natural. This condition of the chest often occasions a compression of the thoracic viscera, and thus interferes with the easy performance of their functions; hence arise the difficult breathing and palpitations which are frequently observable in such cases. With respect to the pelvis it was the opinion of the late Mr. John Shaw, that it will be found distorted only in those cases where marks of rickets are found in other parts of the skeleton besides the spine and chest. He made an examination of an extensive series of skeletons in which there were curvatures of the spine, and he found that in some, the deformities were confined to the spine and chest, while in others, he observed marks of rickets in other bones also; but in no single instance of the former class did he find any distortion of the pelvis; and he therefore concluded that in cases of rickets, although the spine and ribs may be deformed, the pelvis will not be found distorted, unless the disease affect the skeleton generally. The distortions of the pelvis are various; the bones may be pressed to one side, or the inlet may be diminished from before backwards, or if the softening be very great, and the patient be able to walk, the ossa innominata may, to a certain extent, be approximated towards each other at certain parts by the pressure of the thigh-bones against the acetabula. The head is larger than natural, and has a sin-

Figs. 98, 99. From preparations in my own collection.

gular appearance from its two grand divisions becoming disproportioned to each other, the facial portion retaining its natural size, while the cranial is much enlarged. It is an observation made by some authorities that in rickety patients there has been found a more early development than usual of the mental faculties.

State of the Parts.—In rickets, the earthy matter is deficient, and the bone is light, spongy, and soft, of the consistence of cartilage, and is easily cut with the knife. The vessels of the bone appear numerous and large, and are loaded with dark-coloured blood. The bone is of a red colour varying in shade from pink to brown. The walls of the long bones become very thin, while the bones of the cranium are considerably increased in thickness, but are changed in structure so as to become reticulated and spongy. The interior of the long bones presents, as during fetal life, a loose and reticulated arrangement; with somewhat of the appearance of a homogeneous substance instead of a distinct medullary cavity and cancellated structure; and instead of being filled with medulla or any oily secretion, as in the healthy state, it contains a reddish or brownish serum. The periosteum is said by Bichat to be generally thickened; other observers have also found it thickened and detached; but Mr. Stanley, who examined an extensive series of bones affected with rickets, did not find this thickened appearance. The condition of bone above described may be succeeded by one of growth and strength, in which the bones increase in density and size by a process resembling, with one exception, that by which the natural growth of the bones in a sound state is carried on. A medullary canal is formed; instead of the reddish serum, the natural oily secretion is deposited; and the distinction between cancellated structure and the compact shell becomes perceptible. The great peculiarity is, that the bones become thickest at the smaller curvatures, where the power of resistance is most required, and the deposition not only takes place on the outer surface, but in some specimens extends into the interior, so as to encroach on the medullary canal, which has been known in some instances to have been at certain parts even obliterated by it.

Treatment.—The proper treatment consists in the employment of all judicious and available means for removing weakness of constitution, and strengthening the general system. For that purpose the most appropriate remedies are, residence in a dry and pure air; sleeping in a large, airy apartment; free exposure to the light and to the sun's rays; nutritious and light diet, attention to clothing, and particularly in the cold season wearing enough to keep up free cutaneous circulation; cold or sea-bathing at the proper season, if the patient be strong enough to undergo the exertion, and if that should not be found advisable, bathing in tepid salt water, or sponging the body; and the regular employment of friction by means of the hair-glove, or flesh-brush. The state of the digestive system, and particularly the due regulation of the bowels should be attended to; and, together with the above means, which are of the utmost importance for strengthening the general system, it is advisable to give some tonic medicine. Of the various remedies belonging to that class the preparations of iron seem to be usually employed with the greatest advantage. Exercise to an extent not inducing fatigue is

beneficial ; but after exercise, and occasionally at different other periods during the day, the patient should recline to relieve the weak parts from the pressure of the superincumbent weight.

MOLLITIES OSSIIUM.

The disease known by the names mollities ossium, osteomalacia, malakosteon, and osteo-sarcosis, is extremely rare, and appears to have been unknown to the ancients. The first distinct account of this malady was given by Gabriel in 1688. He met with an instance of it in a lady, whose bones were flexible, and converted into a reddish substance destitute of fibres. Cases were published in 1691 by Saviard, and in 1700, by Courtial and Lambert; in the "Memoirs of the Royal Academy of Sciences" for 1752, Morand detailed the remarkable case of Madame Supiot, and since that time many well-marked examples are recorded by different observers. From there being so far a resemblance between rickets and mollities ossium, that in both there is softness of bone and deficiency of phosphate of lime, some have supposed them to be the same malady ; but they differ so completely from each other in many respects, that it is very evident they ought to be regarded as entirely distinct diseases. Some of the striking points of difference are the following. Rickets is a very common affection ; mollities ossium is so extremely rare, that, in a period of more than thirty years, no example of it occurred in any of the London Hospitals. Rickets is by no means a dangerous disease ; mollities ossium has invariably proved fatal. Rickets is a disease of early life, and is equally common in both sexes ; whereas mollities ossium takes place in the middle of the period of life ; and all the well-marked examples of it that are recorded, so far as my reading extends, have been in females, with the single exception of the case of Jas. Stevenson, who was attacked with the disease when thirty-five years of age, and after languishing in bed six years died in 1785. In rickets the disease commences while ossification is imperfect, the phosphate of lime never having been deposited to a sufficient extent ; mollities ossium takes place after the process of ossification is perfect, and the phosphate of lime, previously deposited, is in a great measure removed. In mollities ossium the urine is loaded with a deposit consisting of phosphate of lime ; in rickets there is no such deposit. In mollities ossium the patient complains of pain in the bones, and is distressed with irritative fever ; whereas, these symptoms are not present in rickets, or if present, they arise from other constitutional diseases. By way of further description of this very remarkable disease, I shall state a few particulars of some of the most extraordinary examples on record. The first case I shall mention is that of Ann Elizabeth Queriot, recorded by Dr. Hosty in the forty-eighth volume of the "Philosophical Transactions." This person was attacked at the age of thirty-six, soon after the birth of her first child. She was distressed with fever, profuse perspiration, and violent pains in the bones ; and the disease was attended with a deposition of a white sediment in the urine. The disease continued about two years, and the bones became so soft that they bent in various directions, and so much distorted that her lower extremities turned upwards so as to lie in a line parallel with her body. After her death the

bones were found to be so soft, that they could be easily cut with a knife, and so flexible, that although the extremities had assumed a curved direction, they could easily be laid straight. The cavities of the bones contained a reddish blood-like fluid instead of marrow. No cause could be assigned for the disease, and during its progress she was three times pregnant.

Another remarkable case is that of Madame Supiot. Her disease was attended with great general weakness, fever, pains over the whole body, and a white sediment in the urine. General softening took place in her bones, so that they yielded to the action of the muscles, and the distortion was so complete, that her lower extremities were drawn upwards, and her feet lay by the sides of her head. Her disease lasted five years, during which period she was three times pregnant. For some time before she was attacked with this disease, and for two years afterwards, she was addicted to the habit of eating kitchen salt, and it is stated that she used to take a pound and a half a week without mingling it with her food. To this habit some have attributed her disease; a habit, it may be remarked, to which some of the other persons who have been subjects of this malady were addicted. After death, her bones were found to be soft, sectile, and flexible, and loaded with a bloody fluid.

As further peculiarities in the state of the bones in this disease, it may be stated, that the cancellated structure disappears, and in its place is found a reddish soft substance, from which on a section being made, a bloody serum exudes; and the place of the marrow is occupied by a substance like clotted blood.

FRAGILITAS OSSIUM.

In this state the animal matter is comparatively less abundant than the earthy. It occurs in old age as a consequence of the change which takes place in the structure of the bones at that advanced period; but it is also met with in middle age, in which case it is symptomatic of some other disease, such as cancer, scurvy, or syphilis: in these states it sometimes prevails to a great degree, and is rarely amenable to treatment.

[EXOSTOSIS.

Exostosis is an unnatural enlargement of bone, exhibiting various sizes and shapes. The tumour may involve the whole bone, or it may be confined to a small portion. It may form rounded prominences, which are attached by narrow or broad bases; and sometimes the growth has the form of elongated spines terminating in a point. The increased development of bone may arise from the periosteum, the cellular structure, or from the medullary membrane.

The structure of the tumour resembles ordinary bone, and may be either laminated, cellular, or compact, in its interior. All bones are liable to exostosis, but it more frequently occurs in long bones, particularly in the humerus, femur, and tibia. There may be some constitutional peculiarity favouring this bony deposit, but the predisposing causes are generally syphilis, scrofula, and gout. Violence frequently

excites inflammation in the bone, by which the equilibrium between absorption and deposit is destroyed, and the excessive deposit takes place in the manner that bones are originally formed and repaired.

Fig. 100.



Symptoms.—Generally there is but little pain, in a healthy constitution, unless the tumour presses on parts particularly sensitive, but if syphilis or scrofula be the cause of the disease, there may be a dull, deep-seated pain. Pain is also more likely to be present when the tumour is of rapid growth; but when the growth is slow, there is but little inconvenience unless it interfere with some important organs. It may press on muscles and impede their action, or it may impede the motion of a joint; when growing from the orbit it may occasion protrusion of the eyeball; or, if from the internal table of the skull it may cause epilepsy.

Care must be taken to distinguish those tumours which are dependent upon syphilitic or scrofulous taints from those which are idiopathic, the latter being inconvenient generally from their size and weight, whilst the former may ulcerate and be attended with constitutional disturbances.

Treatment.—If syphilis or scrofula exist, the constitutional remedies employed in these diseases must be mainly relied on; at the same time pain may be relieved by leeches and anodyne applications. True idiopathic exostosis is generally but little diminished by medical treatment, and if it occasions no inconvenience it should be let alone, but if it mechanically interferes with the function of any part, it is to be removed. The operation will in a great measure depend upon the size and form of the tumour. If it be spiculated, it may be cut down upon, and removed by bone-pliers or a fine saw; but if it has a large base, it may be chiselled off piecemeal. If it be impossible to reach it with instruments, the periosteum should be scraped away, so as to deprive it of its nutrition, and it may exfoliate or be absorbed. The edges of the wound are to be brought together, and inflammation carefully guarded against.

SPINA VENTOSA.

Spina ventosa is swelling involving the whole circumference of a bone, and of a regular form. It consists of a bony crust, which forms the walls of a cavity divided into compartments, which contain either an ichorous fluid, or a reddish, jelly-like substance; or a cheesy, lardaceous substance, and sometimes pieces of cartilage or of dead bone.

It commences with deep-seated, dull pain, which often is the result of external violence. The swelling gradually increases, the skin becomes red, and the shell bursts, discharging its contents. Sometimes the walls are formed merely of expanded periosteum. After the contents are evacuated, the cavity fills with fungous excrescences, which protrude through the opening, and which are very sensitive and easily bleed.

The disease probably commences in an inflammation and ulceration of the medullary membrane, which constantly enlarges the tubular cavity of the bone, and fills it with foul matter, at the same time there is going on a deposit from the external periosteum, which becomes expanded. At first, it might be mistaken for exostosis; but, in exostosis, the tumour is firm and incompressible, whereas, in spina ventosa, it is a mere osseous shell.

It is a disease of slow progress, and very difficult to cure. On the fingers, or metacarpal bones, long-continued pressure may perhaps effect a cure. At the same time, the patient should take iodide of potassium in large doses. Should the tumour burst, and it is recommended by some to open it, the cavity should be cleansed and injected with stimulating washes.

OSTEO-SARCOMA.

Osteo-sarcoma is a tumour formed upon a bone, but consists not merely of bone, but also of flesh, fat, jelly, and cartilage. It is dependent upon some constitutional vice, either venereal, scrofulous, or gouty, often excited by an external injury.

Boyer considers that it corresponds to the cancerous affection of the soft parts, and that, after its removal by amputation, it will return in other parts of the body.

The tumour becomes large and nodulated, and some parts are firm, and others are soft and elastic. Upon dissection, the muscles and tendons will be found to be expanded, and of a pearly-white colour. The various coverings will be found much matted together and firmly adherent to the bone. Upon cutting into the bone, it will be found to contain cells filled with medullary or gelatinous matter, intersected with bony spiculae.

Its growth is attended with severe and lancinating pain. The skin is stretched and then inflamed, finally ulceration occurs, which produces hectic and death.

Treatment. The treatment in the early stage of the formation is similar to that for exostosis, but amputation will generally be found necessary.—ED.]

Fig. 101.



CHAPTER IX.

DISEASES OF JOINTS.

ACUTE SYNOVITIS.

Anatomical Characters.—The first effects of inflammation of a synovial membrane are, that the membrane, instead of being pale, thin, smooth, and translucent, as in the sound state, becomes red, preternaturally turgid and opaque, with dulness of its surface. The redness depends on increased vascularity, and may present the appearance of crimson or brownish spots, or it may be diffused over the membrane. There is at the same time a preternatural secretion of synovia, which is of a more aqueous character than in the healthy state, and of a less albuminous quality. As the inflammation advances, other changes take place both in the membrane and in the fluid. The membrane becomes considerably thickened by interstitial exudation; it has some degree of pulpiness with redness, and entirely loses its translucency. The absence of the natural smooth glistening appearance is more decidedly observed on its internal surface, to which lymph is often found adherent, giving it a rough appearance; and if the inflammation be of considerable standing, the lymph may be effused not only on its internal surface, so as to make that surface irregular, and into the substance of the tissue, giving rise to thickening, but also into the cellular tissue external to the membrane, and by which it is connected with the surrounding parts. The membrane at this stage is much distended with a fluid of a serous character, having albuminous or curdy flakes floating in it, and hence called sero-albuminous. This is the stage at which adhesion of opposite sides of the membrane may take place, but such an occurrence is comparatively rare, partly in consequence of the great distension from synovia, and partly from the tendency of the inflammation to increase. At a more advanced period the internal surface is more extensively covered by lymph, which becomes in a measure organised, and forms a secreting surface. There are great varieties as to the extent and thickness of the effused lymph, and also of the appearance of its free surface. In many instances it covers the whole of the synovial membrane, so that no part of it can be seen on laying open the joint; in some it is comparatively thin, and in others it forms thick projecting masses. These varieties occasion also a great difference with regard to the surface of the cavity of the joint, which thus exhibits a greater or less degree of irregularity. The adventitious tissue, as it has been called, becomes organised, and secretes purulent matter into the joint, giving rise to great distension.

At this stage the articulation may be regarded as forming an acute abscess ; and if the synovitis should run its course, the matter may sooner or later point, making its way to the surface by interstitial absorption and ulceration, and at length be discharged by ulcerated openings ; an event which, though it gives temporary relief, is soon followed by a decided aggravation, much more frequently than by a diminution of the inflammatory action. From the extension of the inflammation to the cellular tissue around the joint, lymph and serum are deposited in it, and, in consequence, a doughy and œdematous swelling becomes perceptible between the skin and the distended cavity of the articulation. Destruction of a portion of the membrane and subjacent cartilage by ulceration, and of the bone by caries, are frequent results of acute as well as of chronic synovitis.

The above are the principal results of acute synovitis in unfavourable cases, where the inflammation attains a high grade ; but sometimes the inflammation terminates at an early stage in resolution, and thus structural derangement is prevented ; sometimes it goes on to the effusion of lymph, and produces adhesion, to a certain extent, of the opposite surfaces of the membrane to each other, admitting ultimately a limited motion of the joint, but such adhesions, as has been already stated, are rare ; and sometimes, when the inflammation has attained a higher grade and produced suppuration, and the matter has been discharged, although such cases generally produce, at length, a total disorganization of the joint, they may terminate in ankylosis.

Symptoms.—This disease, very rare in the child, and less uncommon in youth, is most frequently met with in the adult. The knee, ankle, and elbow are more liable to it than the other articulations, but it is most common in the knee. The first symptom experienced by the patient is *pain*, which though slight perhaps at first, gradually increases, and soon becomes very severe. It may be more intense at a particular part, but it is usually felt over the whole of the articulation ; it is aggravated by motion, which is always injurious and often intolerable, and generally by cold, and by the extended position ; it is diminished by rest, by heat, and by slightly bending the joint, and thereby relaxing the structures ; hence the patient has an inclination to maintain the parts in this attitude. Almost synchronous with the pain is *swelling*, which at first depends entirely on the distension of the membrane by synovia. It is as uniform as the ligaments and tendons surrounding the joint will permit, being prominent where the synovial membrane is not confined by these structures. The swelling has very distinct fluctuation ; and if the joint be superficially situated, this peculiarity is very evident, and even the fact of its being caused by a very thin fluid is discernible, and thus an impression is conveyed of the stage as well as of the nature of the disease. As the disease advances, the swelling is caused partly by serous and albuminous effusion into the cellular tissue external to the synovial membrane, but chiefly by distension from the fluid within, which ultimately changes so as to become purulent. The serous and albuminous effusions cause the swelling to feel somewhat œdematous and doughy ; and though the fluctuation be still perceptible, it is more difficult from the examination alone to form an accurate and

decided opinion, in every instance, as to the nature of the fluid within the joint.

Motion of the joint is not only difficult, but painful, and often attended with a grating sensation, which is supposed by some to be caused at an early period by the change in the character of the synovia, which, becoming more aqueous and consequently less lubricating than in a healthy state, is less calculated to diminish the effects of friction. Whether this supposition may or may not be in part correct, it seems more likely that even at first this symptom depends very much on the swollen state of the membrane; and at a more advanced period the impression forced on a careful examiner is, that it arises from the irregularity on the surface of the lining membrane. The parts external to the synovial membrane being involved in a low degree of inflammation, the skin is preternaturally sensitive, red, tense, and hot. The pain is increased on pressure, and the patient maintains the joint in a slightly flexed position. In many instances, the muscles of the limb are affected at times, and especially during sleep, with spasmodic twitches, which aggravate the symptoms; and the rigidity of the muscles, particularly of the flexors, which maintain the joint slightly flexed, is preternaturally increased, and their bellies and tendons may in consequence be felt unusually tense under the common integument.

The severity of the constitutional symptoms varies considerably according to the violence and extent of the inflammation, the grade in which it exists, and the peculiar constitution of the patient. At first the usual symptoms of inflammatory fever appear more or less distinctly marked, but they become more severe, as the disease advances to a higher grade. When the inflammation reaches the suppurating stage, there are frequently rigors, together with a marked aggravation of the symptoms. If the matter be discharged, there is often a diminution of the symptoms, but this is usually of very short duration; and sooner or later the symptoms of inflammatory are changed into those of hectic fever, under which the patient will sink, unless the disease be arrested, or the joint removed.

Causes.—The predisposing cause, which also, to a certain extent, modify the character of the attack, are rheumatism, scrofula, syphilis, and the use of mercury; and so powerfully do these conditions operate, that where they exist, a very slight exciting cause, such as a bruise, a sprain, exposure to cold, a wound, or any injury near a joint is sufficient to induce the disease; and, indeed, it occasionally comes on without any known exciting cause. The most frequent exciting cause, however, is cold, combined with damp, which is more apt to affect the more exposed articulations, as the knee, ankle, and elbow. Synovitis frequently takes place in the progress of diffuse suppurative phlebitis, and it is well known that in persons of rheumatic constitution, inflammation of the synovial membrane of various joints is occasionally produced by the excitement caused by gonorrhœa.

Treatment.—This is both general and local; the former consists of the early and decided employment of the antiphlogistic regimen and treatment in all their details. Bloodletting, when the general system is affected with inflammatory fever, should be employed to an extent

proportioned to the age and strength of the patient, and the violence of the disease. The bowels should occasionally be smartly purged ; but the frequent employment of cathartic medicines is not advisable, as it would interfere with a most important indication, namely, to keep the affected joint at perfect rest. When the disease is not speedily arrested, it is of the utmost importance for checking the diseased action, and thereby preventing structural derangement, and for preserving the joint in a fit state for the future performance of its functions, to bring the system under the influence of mercury. With this view calomel and opium are prescribed with advantage. When circumstances render it injudicious to have recourse to mercury, much benefit is often experienced from the use of the tartrate of antimony, and in persons of a rheumatic diathesis the exhibition of colchicum, to an extent sufficient to produce in some degree its peculiar effects on the system, usually leads to the happiest results. Such are the principal remedies, as far as regards constitutional treatment in acute synovitis, and they ought to be employed at an early period, and to be carried to as great an extent as may seem necessary and judicious, so as to prevent, if possible, the occurrence of structural derangement.

As regards local treatment, one of the most important indications is to keep the joint at perfect rest. The state of complete repose must be strictly enjoined not only during the acute stage, when in consequence of the pain caused by motion the patient has little inclination to move it, but also till all inflammatory action has subsided ; for when the inflammation has become chronic the symptoms are invariably aggravated after motion, although pain may not be felt at the time ; and it cannot be doubted that extensive disorganization has often resulted, and many a limb has been lost, from prematurely and imprudently resuming motion. The attitude in which a joint should be kept at rest, must vary according to the situation of the joint ; but it may be given as a general rule, that it should be maintained as nearly as possible in that position in which it will be most serviceable and convenient, provided the joint remains stiff, or with great limitation of its motion. The means to be employed for preserving the joint at rest may vary. The limb is often gently bound in the acute stage to a pillow, and at a later period to a suitable splint. Local depletion is important, either by leeches or cupping, or, which is often found to answer very well, first by the former, and afterwards by the latter. The efficient application either of cold by means of evaporating lotions, or of heat with moisture by poultices or fomentations will be found useful : in making the choice between these two applications, heat and cold, the best guide will be the patient's feelings ; for whichever is most grateful to the feelings will be most beneficial. By the judicious and early employment of the above constitutional and local treatment the inflammatory action is in many instances subdued ; and with the continuance of the antiphlogistic regimen and rest of the joint, its effects disappear ; and then by gradual and cautious trials the functions of the articulation may be resumed. If, however, the inflammation does not yield under the above treatment, though carried to as great an extent as prudence will allow, it is advisable to employ some of the forms of counter-irritation, of which one of the most

efficient is by blisters. But it is important that care be taken never to apply a blister over a joint in acute synovitis, unless the joint be deeply seated, or the inflammation has become chronic, and depletion has preceded the application. The inflammation would probably be increased by a blister applied over a joint superficially situated, the disease in the acute stage being so susceptible of aggravation and there not being room as when the joint is deeply seated, for the blister to act on the principle of derivation. If it is ascertained beyond all doubt that suppuration has taken place, it is advisable to discharge the matter as in other acute abscesses by free direct incision; but as nothing could be more injudicious than to make an opening into a joint distended with serous or even sero-purulent effusion, the evidence of suppuration should be very clear. If any doubt remain, the nature of the fluid may be ascertained by the introduction of a grooved needle. After such an opening and the discharge of the matter, an attempt should be made to obtain anchylosis, and for this end rest of the joint and attention to all means likely to improve the general health are essential; but as might be anticipated, our hopes are often disappointed, and too generally it becomes needful to remove the limb in order to preserve the patient from sinking under the accompanying hectic fever.

CHRONIC SYNOVITIS.

Chronic synovitis most frequently occurs in persons who have been affected with syphilis or mercury, or who are of a rheumatic diathesis: it is, however, occasionally met with in others also. It is frequently excited by that kind of injury termed a sprain, or by any local mechanical injury, as a blow or a contusion, or by exposure to cold and damp. In many instances it is the form of perverted action ultimately assumed in cases which were originally acute.

Anatomical Characters.—The synovial membrane becomes opaque, thick, and pulpy, and preternaturally vascular; and its free surface, instead of being smooth, becomes villous, or granular, and the cavity of the joint is filled with a fluid which at first is serous, but ultimately by mingling with a puriform secretion, becomes sero-purulent; or, from the absorption of the thinner part, entirely purulent. For a considerable period the changes are confined to the membrane and its contents, and hence arises the difference in the superimposed parts during the early stages of acute and chronic synovitis; but by a continuation of the morbid action, or by the intervention of an acute attack, the extra-capsular filamentous tissue becomes affected, and infiltrated with a jelly-like substance, and the membrane may ulcerate and the cartilage be destroyed by ulceration; and this may be followed by destruction of a portion of the bone and the total disorganization of the joint.

Symptoms.—If the disease be chronic from the commencement, the early symptoms will differ from those of acute synovitis. There will be no redness of the skin, no particular heat, nor will the pain be very acute, nor much aggravated at the time by motion. On this account, patients have not the same dread of moving the joint as in acute inflammation; but it is no less necessary to preserve it at complete rest, as motion is followed by an increase of the symptoms. The pain is not

only less severe, but is felt more at a particular part than over all the articulation. Swelling takes place in the course of a short time, but not so soon as in the acute form; it is not uniform, but bulges out, principally in parts where the synovial membrane is not confined by ligaments or tendons; and as the superimposed tissues are not in the first instance involved, fluctuation is exceedingly distinct. In some instances, from the thickening of the membrane itself, and the depositions into the superimposed tissue, which take place during the progress of the disease, the swelling has to a certain extent a doughy or elastic character, and the fluctuation becomes more obscure; but still, on careful examination, it can always be discerned. The motion of the joint is followed by pain; the inclination of the patient is to preserve it more or less flexed, and the flexor muscles are found to be tense, the others flabby and relaxed. If the disease be of long continuance, the swelling of the joint becomes very great; and presents a striking contrast to the rest of the limb, which is often greatly emaciated from interstitial absorption of all the structures, both hard and soft. Frequently the veins over the joints are greatly distended, and the skin from its wrinkles being unfolded by the tension, has a shining appearance. If the disease run its course, the matter may point at a particular part, and make its way to the surface by interstitial absorption and ulceration.

In some instances the disease is chronic from the very commencement, in others it is at first acute and afterward chronic. In some cases the symptoms continue chronic throughout, and in others they are for the most part chronic, but with occasional aggravation from accession of acute symptoms. If the symptoms have been chronic from the commencement, the patient may not have experienced any inflammatory fever; whereas, if the disease was at first acute, the signs of inflammatory fever are exhibited while the acute stage continues. The constitutional disturbance, however, which sooner or later takes place in every instance where the disease does not come to a favourable termination, is the accession of hectic fever, which will prove fatal unless the joint be removed.

Treatment.—As regards the constitutional treatment, which is of very great importance, it may be said that in the absence of any peculiar cachexy, the chief points are to enjoin the antiphlogistic regimen, to regulate the bowels, to preserve the digestive apparatus, if possible, in a proper state for the performance of its functions, and to adopt all prudent measures for maintaining the general health. When hectic fever supervenes, the strength should be kept up as much as possible by nourishing diet, and such tonic remedies and other means, as seem most suitable to the particular circumstances of the case. When the disease arises from syphilis, a well-regulated course of mercury is necessary; when from rheumatism, the Vinum Colchici will prove highly beneficial; and when from the abuse of mercury, or from injudicious exposure during or after a mercurial course, the happiest effects often result from the use of sarsaparilla, combined with the iodide of potassium. In cases especially where synovitis is combined with in-

flammation of the periosteum, the last-mentioned remedies are often highly beneficial.

With regard to local treatment, in this as in all cases where joints are diseased, it is most essential that rest be observed; if this be neglected, all other means will be of no avail. Local depletion by leeching or cupping, the latter being generally preferable in chronic synovitis, will be found advantageous in the early stage, not only for checking the inflammation, but also for rendering it safe to employ counter-irritation. At the same early period the efficient application of cold is usually grateful to the feelings of the patient, and beneficial. But one of the most valuable remedies, both for subduing the inflammation, and also for promoting the removal of its effects, is counter-irritation, which will be most efficiently employed by the repeated application of blisters in the immediate neighbourhood rather than directly over a joint, unless it be deep-seated.

These are the principal remedies on which reliance can be placed for checking chronic synovitis. The treatment, therefore, may be said, in the first instance, to consist in the employment of rest, local depletion, cold applications, and counter irritation by means of blisters. At a much later period, when the inflammation is considerably subdued, benefit is often derived from some of the other forms of counter-irritation. Some of the principal applications for this purpose are, small caustic issues, or the application of the moxa, in the proximity of the joint. Other excellent modes of employing counter-irritation are painting the joint with the tincture of iodine, or brushing it over with a strong solution of the nitrate of silver, or, after having damped the skin with water, rubbing it very gently with the solid nitrate. These applications must be used with caution, and the surgeon must watch against recurrence of acute inflammatory action; and to diminish that risk, it is prudent to delay the employment of some of the forms of counter-irritation until the acute inflammation has been in great measure subdued.

Under the above treatment the inflammation and its effects may disappear, and in the course of time, by passive motion and friction, the motion of the joint may be restored, and the patient allowed to use the limb. Often, however, there remains a stiffness of the joint from the thickening of the soft tissues, sometimes hydrops articuli; for the removal of which the following treatment is recommended:—

Stiffness from Thickening of the Soft Tissues.—The principal remedies are, the repeated application of blisters, so often beneficial from their well-known effect in promoting absorption; pressure by means of a roller with or without some discutient ointment; friction by the hand with some dry powder; warm water poured on the joint, which is useful not only from the relaxing effect of the heat combined with moisture, but also by causing friction, especially if it be poured from a considerable height; the vapour bath, together with shampooing in the bath, and passive motion. Whenever rubbing, shampooing, or friction is employed, the effects must be carefully watched; and if the treatment should be observed to excite any inflammation, it must be immediately discontinued. Of course nothing could be more injudicious than to have re-

course to rubbing, friction, pressure, or motion, while any inflammatory action remains.

Hydrops articuli is the name given to that condition in which a joint remains distended with synovia, but without pain, redness, or any other symptom than the swelling, and the sense of fulness, and often of weakness, which it occasions. After the subsidence of the inflammation, the fluid is in most instances absorbed spontaneously. When, however, this does not take place, the principal means adopted for promoting absorption are, friction by the hand with any dry powder; or rubbing the joint with the camphorated mercurial ointment; or with the ointment of the iodide of potassium; pressure by means of a roller, or pressure accompanied by the rubbing of the joint with the iodide of potassium ointment, which I have found to produce absorption very speedily. Among the most successful methods, the repeated application of blisters directly over the joint, if it be deeply seated, or in the immediate neighbourhood, if it be superficial, and pencilling the joint with the tincture of iodine, with or without its internal use, deserve to be mentioned. In some cases, local acupuncture has been resorted to, either as a preliminary step to drawing off the fluid by means of the exhausted cupping-glasses; or with a view to allow the fluid to escape into the surrounding tissue, so as to convert the case into one of diffuse oedema.

But this procedure, if any inflammation whatever remain about the joint, will be of no avail in accomplishing a cure, since the fluid will be very quickly secreted again, and if there be no inflammation, it is unnecessary, inasmuch as the disease usually yields to some of the less hazardous methods already mentioned; but if, after the employment of other means, the disease should still persist, still, when it is remembered, that the puncturing of a joint is by no means free from the risk of exciting a fresh inflammatory attack, it does appear a matter of very doubtful propriety to recommend, for the removal of an inconvenience, a procedure, which, though it has doubtless been frequently adopted without such a result, may possibly excite a serious inflammation. The same treatment has also been proposed as for hydrocele, namely, to draw off the fluid, and inject tincture of iodine into the joint; than which nothing could be more injudicious, or more justly deserving of unqualified condemnation.

SCROFULOUS CHRONIC SYNOVITIS.

This disease, called by some authors the gelatinous degeneration of the synovial membrane, is sometimes attributed to a slight injury, as a bruise, or sprain: but it often presents itself without any assignable exciting cause. It is most frequently met with during adolescence, though, certainly, it is not confined to that period. The subjects of it are always of a scrofulous habit; and it is not only accompanied, but also preceded, in most instances, by the symptoms of scrofulous cachexy.

Symptoms.—One of the first symptoms is, swelling about the joint, which slowly advances, and is of a doughy elastic nature; but which cannot be said to be characterized by distinct fluctuation. This disease is recognised as much by its negative as by its positive symptoms, and is remarkable for the length of time the skin retains its natural appear-

ance. There is little or no pain, scarcely any tenderness on pressure, and at this stage none of the local symptoms of inflammation, except swelling, which, with stiffness or diminished mobility and a sense of weakness, are the only local signs of the disease. In the further progress of the disease the swelling continues to enlarge, and the rest of the limb becomes wasted. After continuing for months, and often for a longer period, the disease either changes favourably and the swelling diminishes, or it goes on to suppuration of the joint, attended with great aggravation both of the local symptoms and of those of the scrofulous cachexy, and ending in the destruction of portions of the cartilages and bones; and unless some of the forms of ankylosis should occur, which after this stage of the disease is an exceedingly rare event, the only chance of saving the patient's life will be the removal of the affected part.

State of the Parts.—In the case of a young man, who was the subject of this disease in the knee, and who died of phthisis, I had an opportunity, at a post mortem examination, of making a dissection of the joint. I found the synovial membrane thickened, of a gelatinous appearance, of a grayish white colour, and at some parts considerably injected; the synovial fluid was flaky and much more opaque than is natural; and there was an effusion of a gelatinous character into the cellular tissue, so that it was thickened; and the skin, the synovial membrane, the cellular tissue, and the ligaments were all matted together. In another example of this disease in the knee, I lately had occasion to perform amputation, and found the same morbid alterations of structure as in the last-mentioned case; and the same matting together of tissues, with the additional peculiarities that the membrane was much more injected; the part of it which covers the cartilages of the femur was destroyed; the cartilages were removed; the extremity of the femur was carious; and the fluid in the joint was sero-purulent.

Treatment.—Since this disease is connected with scrofula, the treatment adapted to that particular state of the constitution is, during the whole of its progress, indispensable; and, however necessary local treatment may be, it is equally important to employ such means as are calculated to operate favourably on the general system. The local treatment is nearly the same as in simple chronic synovitis; but with reference to local depletion, there are two considerations which will prevent the surgeon from prescribing it, except so far as is absolutely necessary; the one, that it has much less effect in controlling scrofulous than common inflammation; the other, that free depletion is very unfavourable to the state of the general system. The treatment may be stated to consist—in preserving the joint at perfect rest through the entire continuance of the disease; in endeavouring to arrest acute inflammation when it occurs, by rest, cold applications and local depletion, the last being employed as sparingly as possible; in attempting to subdue inflammation when more chronic, by rest and counter-irritation, slight depletion as in simple chronic synovitis, preceding the application of the counter-irritants; and after the inflammation has been subdued, in employing means for fulfilling these three indications, namely, to keep the joint at rest, to apply pressure in order to promote absorption, and to use some

of the most efficient applications for stimulating the absorbents. These three indications can be effectively combined by Mr. Scott's treatment, which "consists in cleansing the surface of the joint with a sponge, soft brown soap, and warm water, and then thoroughly drying it. The part is then rubbed with a sponge soaked in camphorated spirit of wine, and afterwards covered with cerate made with equal parts of ceratum saponis and the ung. hydr. fort. cum camphorâ. This is thickly spread on large square pices of lint, applied entirely round the joint, and supported with broad strips of the emplastrum plumbi. Over these straps is placed an additional covering of emplastrum saponis, spread on thick leather and cut into four broad pieces, one for each side of the joint. Lastly, the whole is secured with a calico bandage, which is not to be applied so as to cause any uneasiness from pressure." In this and in some other affections of joints, the above treatment is often instituted with the happiest results; but it must always be employed with the greatest caution, and its effects constantly watched; otherwise very serious consequences may result. It ought never to be adopted while any inflammation exists. The pressure should at first be slight, and gradually increased at future dressings; and even while it appears to be attended with benefit, the symptoms must be most carefully observed, so that if there should, from any circumstance, be a recurrence of inflammation, however slight, the dressings may be immediately removed, as the pressure would be exceedingly injurious. These are the principal precautions, and it is important that they be not neglected.

Another excellent method of fulfilling the same three indications is, —to excite absorption by applying pieces of lint covered with ung. hydr. fort. cum camphorâ, or equal parts of that ointment, and the ointment of the iodide of potassium; to produce pressure by an elastic cotton roller; and to preserve the joint at rest by a leather or wooden splint retained by suitable retentive appliances.

This method I have often employed with advantage; and it has the recommendation that the dressings can be removed without any trouble, as often as the surgeon wishes to see the appearance of the joint. If, unfortunately, suppuration should take place, the matter must be discharged, and the treatment formerly mentioned as proper under such circumstances strictly enjoined. If the desired result should not thus be obtained, but the patient be in danger of sinking under the continued irritation and discharge, the local disease must be removed either by excision of the joint, or amputation of the limb.

THICKENING, WITH MORBID ALTERATION OF STRUCTURE, OR BROWN INTRACTABLE DEGENERATION OF THE SYNOVIAL MEMBRANE.

This disease, sometimes called the pulpy thickening of the synovial membrane, is characterized by certain marks or appearances, not found in any other disease of the joints. The synovial membrane is converted into a pulpy substance of a brownish, or reddish brown colour, and of a thickness usually varying from a line to half an inch, but sometimes even exceeding an inch. This substance is not of uniform consistence, but is intersected in various directions by a kind of fibrous banda.

The disease generally commences in the reflected portions of the

synovial membrane, and most frequently occurs in the knee joint ; but Mr. Hodgson met with one example of it in the ankle joint, and with another in one of the phalangeal articulations of the fingers. I have in my possession an uncommonly well-marked example of this disease affecting the synovial membrane of the shoulder-joint, which I took from a male subject brought to the anatomical rooms of this University, when I taught anatomy. As at that time subjects were procured by exhumation, I found it impossible to obtain a history of the case. The whole of the synovial membrane is more or less affected ; at some parts it is about two lines in thickness, in others more than half an inch. It is of a light brown colour on its articular surface, and of a pulpy appearance, with firm intersections of a fibrous consistence. The cartilages covering the bones seem to be entire ; the joint contained a thick opaque fluid, apparently synovia, mixed with pus. No other joints than those already mentioned have hitherto been found affected with this disease. It occurs principally in young persons, and in adults ; but is so exceedingly rare after the middle period of life, that Sir Benjamin Brodie has met with only one example. If allowed to run its course, it may terminate either in suppurative inflammation followed by ulceration and complete destruction of the joint, or in malignant tumour. In a beautiful specimen of this disease, affecting the synovial membrane of the knee joint, which I took from a boy named Bisset, in whose case I found it necessary to perform amputation, the whole of the synovial membrane was affected, except the portion which is behind the patella ; but the parts covering the articular cartilages of the femur and tibia were much less affected than that which is situated round the circumference of the joint, where it was in some parts an inch in thickness, and projected into the cavity of the articulation. The articular surface was of a very pale brown colour ; and the structure, when cut into, had a pulpy appearance, with white intersections of a fibrous consistence, and very much resembling those of carcinoma. At some few spots there were one or two injected vessels, but no vascular or other marks of inflammation could be discovered on the most careful examination ; and the impression conveyed to me and also to some friends well qualified to judge was, that the change of structure was the result of some other process than inflammation. The ligaments were entire, and the joint contained a ropy fluid.

It is remarked by Sir Benjamin Brodie, to whom we are indebted for first pointing out this particular disease, that, "It would add much to the utility of researches in morbid anatomy, if it were more frequently attempted to ascertain what is the first change in the organization of the affected part which disease produces, and from thence to trace the gradual progress of the other changes which take place, until the destruction of the natural organization is completed." It is the opinion of Sir Benjamin, that this disease belongs to the same order as scirrhus of the breast, the medullary sarcoma or fungus hæmatodes of the testicle, and numerous other diseases in which the natural structure of the affected organ is destroyed, and a new and different organ formed in its place, and that although in its progress inflammation comes on, the degeneration into pulpy substance with fibrous intersections is not a

result of common inflammation, but of a different kind of morbid action. Some surgeons consider the change of structure to be the result of a chronic form of inflammation. I have not seen a sufficient number of specimens at an early period of the disease to enable me to form a decided judgment; but those which I have seen, and especially the example of it in the knee joint described above, leave no doubt in my mind that the opinion of Sir Benjamin Brodie is correct.

Symptoms.—Stiffness, accompanied with a sense of weakness not amounting to pain, first engages the attention of the patient; and as the disease advances, pain comes on, but usually it is for a long time inconsiderable, and is increased by exercise. Swelling is soon perceptible, which has a doughy elastic feeling without fluctuation, and is irregular in shape. This elastic feeling is often very deceptive, and it is only after a very careful examination, under such circumstances, that the surgeon can satisfy himself of the absence of fluctuation. The stiffness gradually increases, and although in some instances a certain degree of mobility is retained, the joint in the great majority of cases at length scarcely admits of any motion. With enlargement of the joint there is also wasting of the limb. The disease begins very gradually, and for a long time its progress is slow; but when it reaches its advanced stages, the pain is often very great, and then its onward course is generally rapid. The disease, as has been already stated, may terminate either, as it usually does, in suppurative inflammation, followed by total destruction of the joint, or in malignant tumour, which, however, is comparatively rare. In the former case, there will be the local and constitutional symptoms of suppurative inflammation; in the latter, the articulation becomes much swollen, and communicates to the finger a sensation as if greatly distended with fluid; the skin becomes tense, glistening, and prominently marked by dilated tortuous veins; the pain is severe and shooting, and attended with a sense of great weight; if an incision is made, blood only escapes, and the disease is now evidently of a malignant nature. For a considerable time constitutional symptoms are not very distinctly marked; but a modified form of hectic supervenes, which, however, becomes much more urgent, when the suppurative crisis arrives. The patient becomes sallow, greatly emaciated, debilitated, and dispirited, and shows the usual symptoms of the cachexy attendant on malignant disease.

Treatment.—As we are not acquainted with any treatment by which the natural structure of any organ after being entirely changed can be restored, a knowledge of the state of the parts would lead us to the conclusion, which the present state of our experience may be said to authorize, that this disease is incurable. In its early stage it may be somewhat palliated, and its progress rendered less rapid, by means of rest, attention to the general health, and cold lotions; and the pain attendant on the suppurative crisis and the destruction of the cartilages may be considerably diminished by warm applications; and thus a certain degree of relief may be obtained. Sir Benjamin Brodie, after referring to the partial benefit derived from this treatment, says, "But no method, with which I am acquainted, is capable of doing more than somewhat checking the progress, and somewhat relieving the symptoms of the complaint. In every case of which I have had an opportunity of

seeing the termination, the ulceration of the cartilages, the formation of abscesses in the cavity of the joint, and the consequent disturbance of the patient's general health, have ultimately rendered the amputation of the limb necessary, in order to preserve the patient's life. At this period, therefore, the surgeon is called upon to recommend and urge an operation; but at an earlier period it is a matter of choice with the patient, whether he will live with the incumbrance of a useless limb till the advanced stage of the disease renders its removal indispensable, or whether he will submit to the loss of it, before the absolute necessity for losing it exists." If amputation be deferred until the disease result in a malignant tumour, it will then be too late to derive from it any further benefit, than the doubtful chance of merely, for a short time, deferring the fatal termination. Some surgeons seem to think that at an early stage the disease may be cured, and they speak favourably of the result of treatment similar to that recommended for scrofulous synovitis. For my own part, having found it necessary to amputate in every instance which has come under my observation, I agree with Sir Benjamin Brodie in considering it incurable.

FIMBRIATED SYNOVIAL MEMBRANE.

In this disease the free surface of the synovial membrane is studded over with innumerable bodies termed fimbriæ, of a white or yellowish white colour, and usually varying in size from a millet to a common pea;

Fig. 102.



but some are found resembling, both in size and appearance, the appendices epiploicæ of the large intestines. They are smooth and uniform in their outline, and of a glistening appearance, as if invested with a capsule of the synovial membrane. They are sometimes broad, sometimes constricted in their base, and connected to the synovial membrane by a narrow pedicle. In some cases, these bodies pervade the whole articulation; in others, they merely fringe the synovial membrane. They usually have the appearance of being formed of a capsule of the synovial membrane filled with a fatty substance, and occasionally they are somewhat of a cartilaginous consistence.

This being a very rare disease of the synovial membrane, little is as yet understood either of its causes, or of the nature of the morbid action by which the change of structure is produced. I have seen one specimen of it in the museum of the University of Edinburgh, and three most beautiful specimens in the museum of St. George's Hospital, London; of one of

the best of which Mr. Hewitt kindly allowed an artist to take a drawing for me, a copy of which is here given.

Symptoms.—Pain during and after exercise, and a grating sensation on moving the articulatory surfaces of the bones on each other. The joint becomes swollen and elastic, with stiffness and more or less limitation of its motion.

DISEASE OF ARTICULAR CARTILAGE.

DESTRUCTION OF CARTILAGE.

Destruction of the substance of cartilage may take place without the slightest trace of disease in other structures, and as the result of actions confined to the cartilage itself; in which circumstances it is said to be *original* or *primary*; or, it may be the consequence of acute, chronic, or scrofulous synovitis, or of inflammation of the portion of bone to which the cartilage adheres, or of scrofulous degeneration of the joint-ends of bone; when it is called *secondary*. The destruction may thus be either original or secondary; it may be extremely rapid or very slow, constituting acute or chronic destruction; it may be limited or extensive; it may be superficial and limited, or superficial and extensive, or it may go through the whole thickness of part of the cartilage, and thus penetrate to the bone. Though it most frequently commences on the free surface, it may commence in the middle of the substance of the cartilage, or, if it proceed from disease of the bone, on the attached surface. It may be unattended with the slightest vestige of disease of the synovial membrane or bone; it may even be cured by the unassisted efforts of nature, without the occurrence of any new exudation, by the formation of a fibro-nucleated membrane from the substance of the cartilage itself; or, it may lead to disease of the synovial membrane or bone, ending in total destruction of the joint. It is very remarkable that in all these varieties, the structural changes in the cartilage are found, on microscopical examination, to be similar, consisting in changes in the structure and arrangement of the cells, and alterations in the hyaline substance.

When a thin slice of articular cartilage, in a healthy state, is examined with a microscope, it is seen to consist of an apparently homogeneous substance called the hyaline substance or matrix, with nucleated cells, named also cartilage corpuscles, disseminated through it with a certain order and arrangement. No blood-vessels are seen in cartilage, nor is there the slightest reason for believing that it contains any. Whatever nutrient fluid it requires, is derived from the vessels of adjoining textures, and is conveyed, it is believed, through the tissue by imbibition. No nerves have been traced in cartilage, and it is known to be destitute of sensibility. From this brief description of articular cartilage in its healthy state, the following account of its morbid changes will be more intelligible.

To Professor Goodsir and Dr. Redfern belong the merit of having successfully investigated the changes in the form, contents, and arrangement of the cells, and the alterations in the hyaline substance, which take place in the various forms of destruction of articular cartilage, and of having brought forward the views which are at present entertained

regarding those changes. The principal structural changes observed in the cells and in the hyaline substance are the following.

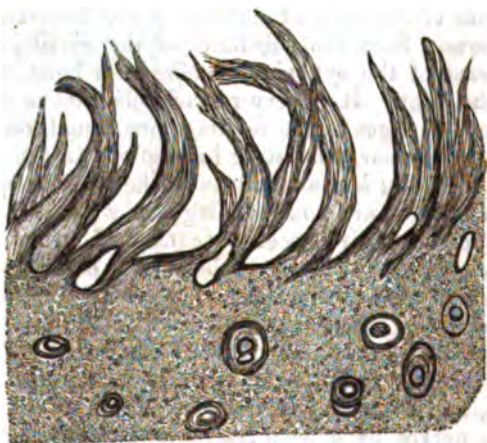
Fig. 103.



As was first pointed out by Professor Goodsir, destruction of cartilage is always accompanied by enlargement, change of form, and irregular arrangement of the cells. They become "larger, rounded or oviform, and instead of two or three nucleated cells in their interior, contain a mass of them." The enlarged corpuscles at the surface burst, and discharge their contents, so that the disintegrated surface presents a series of cavities. In many instances the contents of the cells, after having been discharged, assist the altered hyaline substance in the formation of a fibro-nucleated membrane on the surface of the diseased portion of the cartilage. In such cases the nuclei become elongated and incorporated with the fibres

of the split-up hyaline substance; and this is one of the most remarkable

Fig. 104.



transformations of the nuclei which have as yet been observed. Other changes of the nuclei, of frequent occurrence, are their conversion into

Fig. 103. Diseased articular cartilage, showing enlargement of the corpuscles, and the contents of the more superficial thrown out into the intercorpuscular substance.—Copied from Redfern.

Fig. 104. Vertical section from the cartilage of the central part of the internal glenoid cavity of the tibia, showing the splitting into fibres on the surface.—Copied from Redfern.

fatty granules, and into fat globules. The conversion of the nuclei into drops of oil was first described by Mr. Rainy. In cases of very rapid destruction of cartilage, it appears that the changes are almost entirely confined to the cells.

The alterations in the hyaline substance consist of its losing its natural homogeneous appearance, and in its being split up into bands and fibres, which project into the joint. These bands become incorporated with the liberated and elongated nuclei, and thus constitute a fibro-nucleated membrane, without the aid of any exudation, and by changes in the cartilage itself without any other texture being involved. These fibres constitute processes projecting into the joint, separated from each other at their free extremities, and at their attached extremities, continuous with the hyaline substance. Dr. Redfern was the first to demonstrate the conversion of the hyaline substance into fibres in disease of articular cartilage. The cartilage, during the whole of this process,

Fig. 106.



remains non-vascular, and the membrane above referred to, is regarded as the result, not the cause of the destruction. If other textures become involved, exudation may take place from them, and the exuding matter, becoming pervaded by vessels derived from the involved texture, constitutes a vascular adventitious membrane in contact with the diseased portion of cartilage. This membrane is sometimes formed between the bone and the cartilage; and there can be no doubt that to its formation in that position and its becoming pervaded by vessels derived from the bone, may be attributed the erroneous impression entertained by some observers, that in one form of destruction of articular cartilage, the destruction is preceded by the formation of vessels in the substance of the cartilage itself. The usual situation of the adventitious membrane is on the free surface, and its formation is properly attributed to the synovial membrane becoming involved, and giving out an exudation which becomes pervaded by vessels derived from itself.

Dr. Redfern, in his work on anormal nutrition in articular cartilage, has given the following as the conclusions at which he has arrived in consequence of his investigations.

First,—That all the known forms of disease in articular cartilages are connected with changes in the texture, which are essentially similar to each other.

Second,—That during the progress of these changes, the cells of the

Fig. 106. Cartilage of the patella, showing, on the surface, fibrous tissue with included cells and nuclei.—Copied from Redfern.

cartilage become enlarged, rounded, and filled with corpuscles, in lieu of healthy cells; bursting, subsequently, and discharging their contents into the texture on the surface; whilst the hyaline substance splits into bands and fibres, and the changed hyaline substance, and the discharged corpuscles of the cells, afterwards form, in many cases, a fibro-nucleated membrane on the surface of the diseased cartilage.

Third,—That these changes are referable only to an abnormal nutrition as their immediate cause, and in no case to mechanical or chemical actions, such as attrition or digestion in a diseased secretion.

Fourth,—That most extensive disease may go on in many joints at the same time, and may proceed to destroy the whole thickness of the cartilage in particular parts, without the patient's knowledge, and whilst he is engaged in an active occupation.

Fifth,—That the disease commences most frequently on the free surface; but may proceed from the bone to affect the attached surface, or may take place in the middle of the thickness of the cartilage.

Sixth,—That it is, at least, very doubtful if the symptoms which are believed to indicate the existence of ulceration of articular cartilages, are not really dependent on a morbid change in the bone.

Seventh,—That disease of the whole thickness of an articular cartilage at particular parts, admits of a natural cure, by the formation of a fibro-nucleated membrane from the substance of the cartilage, without the occurrence of any new exudation.

Favourable Results.—These vary according to the depth of the destruction. If only a portion of the cartilage be removed, the destruction not extending through the whole of its depth, the diseased part may be healed, on the subsidence of the abnormal nutrition, by a fibro-nucleated membrane, formed entirely from the cartilage itself, in the manner already described. In such cases, the affected part, as will be understood from what has already been stated, presents a villous appearance.

If the destruction be superficial, and the synovial membrane be involved, there may be incorporated with the fibro-nucleated membrane a depressed cicatrix formed by exudation from the synovial membrane.

When the loss of substance is to a greater depth, exposing the surface of the bone, or when a limited portion of the bone is removed, exudation may take place from the vessels of the bone, and osseous granules, not rising to the level of the cartilage, may occupy the affected part, or the granules may be covered by a depressed cicatrix derived from the synovial membrane.

Reproduction of cartilage never takes place, and instead of any of the above favourable results, the place of disintegrated cartilage may be occupied by an amorphous formation, technically called the porcellaneous deposit. This substance fills up the cavity, and its smooth and polished surface compensates for the want of cartilage and of synovial membrane.

If there happen to be destruction of cartilage and osseous granulations on opposite sides of an articulation, the granulations may unite, and a form of ankylosis be produced. Of many fine specimens of ankylosis in my collection, the first of the accompanying drawings represents one of a section of the hip joint, in which the anky-

losis is very perfect after the whole of the cartilages have been removed; the cancellated structure of the one bone is perfectly continuous with that of the other. The second drawing gives a representation of another very perfect specimen of ankylosis, also in my possession. The third represents a specimen now in my collection, given to me by my late friend Mr. Liston: it is represented in his "Elements of Surgery," and in the second edition of Professor Miller's admirable work on the "Principles of Surgery."

The above are the favourable results; but in many cases, ulceration and other morbid changes advance so far as to involve the whole of the tissues, and ultimately to produce total disorganization of the joint.

Symptoms.—While the destruction is entirely confined to the cartilage, and the other tissues are perfectly healthy, the patient may experience no unusual sensation in the joint. When other tissues become involved, a

Fig. 106.



Fig. 107.



Fig. 108.



Fig. 106. Section of ankylosis of hip joint, showing perfect union. From a preparation in my own collection.

Fig. 107. Perfect ankylosis of hip joint. From a preparation in my own museum.

Fig. 108. Section of ankylosed hip joint, first delineated in Mr. Liston's "Elements of Surgery," and now in my museum.

deep dull uneasiness in the joint, and diminished power of motion, are the first symptoms. The uneasiness at first is slight, not amounting, perhaps, to actual pain; it is only occasional, and is often referred to different parts; but it gradually becomes more severe, constant, and limited to a particular spot. These symptoms are believed to be coeval with the morbid changes in the early stages. While destruction is going on, the pain increases, and as the disease advances, it becomes exceedingly excruciating, especially during the night, the nocturnal exacerbations and involuntary startings of the limbs being very distressing. The pain, at this period, is referred to a particular spot, and is often said by patients to resemble the gnawing of an animal. This is supposed to correspond with the period of the formation of matter. Matter never forms, according to Dr. Redfern, until other tissues have become involved, and he supposes that the pain is produced by morbid changes in the bone, and not by the destruction of the cartilage. The pain is aggravated by motion, and also by pressure, if directed against the diseased portion of the joint. Sympathetic pains are also felt, which vary in situation according to the site of the disease, and the tenderness, on pressure, is not only at the seat of the disease, but sometimes also, although very rarely, at the parts sympathetically affected.

Swelling is a symptom, and for the purpose of diagnosis its characters should be carefully observed. It is long in making its appearance, is slow and gradual in its increase; and deep in situation; it does not bear handling without pain; it is nearly uniform in shape, and destitute of that peculiar bulging out at particular parts which is so characteristic of the swelling in the usual forms of synovitis; and fluctuation, though for a long time obscure, becomes distinct in the advanced stage. It differs from the swelling in synovitis in its shape, and the time of its appearance, not being coeval with the pain; and from the swelling in scrofulous gelatinous degeneration, which, however, it more nearly resembles in shape, in the lateness of its appearance, and in the pain which is felt on pressure. The swelling proceeds partly from the presence of matter within the joint, and partly from serous infiltration into the external soft tissues. These secretions, as the textures closing in the joint are destroyed, at length communicate, and the fluctuation then becomes distinct.

The superimposed muscles become wasted, often giving rise, at an early period, to an unnatural form about the joint; the whole limb becomes emaciated and feeble; its circulation is weak, and there is a tendency to cedema. For a long time the joint is often maintained in a particular position, from the patient feeling in that position some diminution of pain; but in consequence of disorganization of the joint it frequently happens that displacement of the bones ultimately takes place.

At first there may be no constitutional symptoms, but as the disease advances, those of inflammatory fever appear, and ultimately change to the symptoms of the hectic type.

Symptoms of Destruction of Cartilage of the Hip Joint.—When the disease is seated in the hip joint, and proceeds to an advanced stage, it gives rise to pain with diminished power of motion, tenderness on pres-

sure, change in the form of the nates, alteration in the length of the limb, and ultimately to the local and constitutional symptoms of chronic abscess. These symptoms present the characteristics already mentioned in the description of the symptoms hitherto usually regarded as denoting ulceration of cartilage; but they have also some peculiarities, which it may be proper to notice.

The pain is increased by motion, or by pressure of the trochanter inwards, or of the limb upwards, or by any means which direct the pressure against the diseased portion of the joint; and sometimes to relieve the parts affected as much as possible from the pressure, the patient maintains the limb in a position in which the ball of the femur is made to press least against the acetabulum. The pain is felt in the joint, and also at the knee, principally along its inner side; and though the knee is only sympathetically affected, the pain is sometimes more severe there than at the hip, so that it is occasionally difficult to convince a patient that the seat of the disease is not in the knee. This is an exemplification of what is frequently observed, namely, that when disease exists at one set of terminal expansions of a particular nerve, the pain is often referred to the extremities of other branches given off by the same nerve; for the anterior crural nerve gives branches to the hip and also to the knee; and the trunk of the obturator nerve supplies the hip joint with nerves, while its anterior and posterior branches give nerves to the knee.

Tenderness on pressure is felt at the hip, more especially in front of the joint, and posteriorly on the inner side of the great trochanter. It is remarkable that there is sometimes tenderness at the knee, when the sympathetic pain is experienced.

The change in the form of the nates is, that they become flattened by the wasting of the glutei muscles from want of exercise. This is an early symptom, and it makes the nates appear wider than natural; they feel flaccid to the touch, and their under edge is observed to be more loose than in the healthy state. In an advanced stage, the form may be still further changed by the head of the bone being drawn from the acetabulum upon the dorsum of the ilium.

The alteration of the length of the limb has this peculiarity, that there is an apparent elongation in the early stage, and an actual shortening in the advanced. The balance of the pelvis being lost, the sound limb sustains the weight of the body, and raises up the pelvis on that side, while on the other, the pelvis not being supported by the diseased limb, falls down, and thus occasions the apparent elongation; but it is only apparent, for if the measurement be taken in the early stage between a given point of the pelvis, and a given point in the limb on the diseased side, and compared with the measurement between the same points on the sound side, they will be found to be the same. The alteration of the position of the pelvis may cause lateral curvature of the spine, which is often a consequence of this disease. It has been stated by some authors, that in the first stage, apparent shortening has been sometimes observed, instead of apparent lengthening. This is to be attributed to the patient drawing up the pelvis on the diseased side, to enable him to steady the

weight of the body on the other limb; and thus the crista of the ilium becomes higher on the diseased than on the sound side.

In the advanced stage of the disease, the limb becomes shortened; and in most instances, this is owing to the loss of substance and destruction of the head of the bone, and the corresponding changes of the acetabulum, by which the latter becomes widened, allowing the limb to be drawn up by the action of the muscles, while the head of the femur still remains within the acetabulum. In many cases, however, the shortening depends on the actual dislocation of the femur, produced by the action of the muscles, after the ordinary organs of relation, the ligaments, are no longer able to perform their office, owing to the destruction of the portions of bone to which they are attached. The direction in which the femur is dislocated is almost invariably upwards and outwards, but instances have occurred where the dislocation has been into the ischiatic notch, or in front of the foramen ovale, or upwards and forwards upon the pubes. It has also been found in the cavity of the pelvis, of which I met with an example in a young man twenty-five years of age, in whose case the floor and margins of the acetabulum were completely removed. From the history of the case, I thought there was reason to believe that the destructive process had commenced in the soft parts. When dislocation upwards takes place, the toes are directed inwards; but in other circumstances, I have almost invariably found the foot slightly inverted in the first stage, and, in by far the greater number of cases, when unattended with dislocation, slightly everted in the advanced stage.

A general tumefaction takes place about the joint, and afterwards a swelling, which at first presents the peculiarities already described, and at length usually exhibits the characters of an abscess. The abscess is not in all cases found in the same situation, but its appearance is always unfavourable: for, though in children recovery has taken place after the formation of an abscess, in adults it is almost invariably fatal;—the limb becoming wasted, and ultimately cedematous, and the constitutional symptoms soon appearing to be those of hectic fever, with its usual train of consequences.

The disease has been met with at all ages; but it occurs most frequently between the period of puberty and the thirty-fifth year; and it forms, as has been remarked, the majority of cases of hip disease among adults, whereas the disease of the hip most frequently met with among children is that which begins in the cancellated structure of the bones.

Treatment of Destruction of Cartilage.—One of the most important indications during the whole progress of this disease is, to maintain the joint at perfect rest; and unless this be attended to, no treatment will prove of any avail. The limb should be placed in the attitude which will be most useful to the patient in after life, and the means employed for obtaining immunity from motion in that attitude will vary according to the situation of the disease. Local depletion, especially by cupping, is employed, but chiefly as a precaution before using counter-irritation, on which the principal hope of benefit must rest. The preferable form of counter-irritation seems to vary according to the period of life, and to a certain extent according to the seat of the disease. In children, the

best mode is the application of blisters;—and from my own observation, I am of opinion that at the commencement, a succession of small blisters affords the greatest relief, but that afterwards, it is better to keep up irritation of the blistered surface by means of some stimulating ointment. When the disease is in the wrist or the ankle, the application of blisters should be continued throughout, as some of the other modes of producing counter-irritation may be injurious to the tendons, which at those joints are so near the skin.

In adults, caustic issues are preferable to blisters; they are more serviceable in this than in any other disease of the joints, and the best method of employing them is frequently to retouch the parts with the caustic potass. Moxa and the actual cautery are also employed. The latter is very much praised by some surgeons; but, chiefly owing to the difficulty of persuading patients to submit to it, I have not had sufficient experience to enable me to form a decided opinion from my own observation. Of the good effects of issues I can speak with confidence. There are some precautions, however, which ought to be observed in the use of blisters and issues, namely,—not to apply them directly over the joint, but in its immediate neighbourhood, unless the joint be sufficiently deep for them to have room to act on the principle of derivation,—not to employ them after the complete subsidence of pain,—nor to carry them so far as to induce general debility; and when the symptoms of hectic fever appear to demand the removal of the joint, if it be in an accessible situation, then to discontinue them entirely for some time before venturing on such a step, lest the constitutional symptoms should be partly the effect of treatment carried to too great an extent.

SCROFULOUS DISEASE OF THE JOINTS, IN WHICH THE CANCELLED STRUCTURE OF THE BONES IS PRIMARILY AFFECTED.

Morbid Changes.—According to Sir Benjamin Brodie, the first deviation from healthy structure in the cancellous texture of the heads of the bones is, preternatural vascularity. There is also an unusual softness in the bone, from its containing less of earthy matter than in the healthy condition. The cancelli are next filled with a thin, transparent fluid; and, as the disease proceeds, they have a tubercular or cheese-like substance deposited in them. This is followed by inflammation and by absorption of the portion of bone between the morbid deposit and the cartilage, and ultimately by the destruction of the cartilage and synovial membrane: so that a communication is thus opened between the joint and the part containing the morbid deposit, and a portion of the deposit is discharged into the joint, leaving a cavern in the bone. Sir Benjamin Brodie says, “the cartilage ulcerates in spots, the ulceration beginning on that surface which is connected to the bone.” On this subject Goodsir remarks, “In scrofulous disease of the cancellated texture of the heads of bones, or in cases where the joint only is affected, but to the extent of total destruction of the cartilage over part or the whole of its extent, the latter is, during the progress of the ulceration, attacked from its attached surface. Nipple-shaped processes of vascular texture pass from the bone into the attached surface of the cartilage,

the latter undergoing the change already described. It may be undermined for a greater or less extent, or be thrown into the fluid of the joint in small detached portions, or it may entirely disappear.' In all these changes, however, according to the views now entertained, the cartilage itself remains non-vascular. The ulceration of the cartilage and synovial membrane, and the discharge of the deposit originally contained in the bone, are followed by general synovitis, which very rapidly terminates in suppuration; and the contents of the joint, consisting of purulent matter, tubercular degeneration, and the debris of the bone, may ultimately be discharged by ulceration of the external soft tissues. Soon after the disease is fully established, and the communication is opened, as above described, between the diseased cavity and the joint, the changes within the bone are followed by effusion of lymph into the soft parts immediately surrounding the bone, which gives rise to a firm swelling; and at a more advanced period, by effusion of serum into the cellular tissue, which causes slight oedema. There is, at an early stage, a hard swelling from effusion of lymph, and afterwards a swelling with fluctuation from the distension of the synovial membrane by the contents of the cavity of the joint. The skin over the swelling remains white, but from its natural wrinkles being unfolded, it presents a kind of glazed appearance; the veins under it become large, and the parts above and below the joint, weak, soft, and emaciated. The scrofulous or tubercular deposit may be the result of previous perversion of nutrition, or a change in the liquor sanguinis exuded, in consequence of a slight grade of the inflammatory process;—the change into this morbid deposit being believed to depend on the inherent composition or constitution of the liquor sanguinis itself. It is not regarded, therefore, as a disease necessarily of inflammatory origin, although as it advances, a process of inflammation comes to be connected with it. The above appearances are revealed only by dissection.

Symptoms.—Slight pain, or uneasiness scarcely amounting to pain, and felt only at times, and a considerable sense of weakness of the articulation, are usually the earliest symptoms. As the morbid changes advance, the pain becomes more severe, and is for a long time referred by the patient to a particular spot about the extremity of the bone. The pain is of a heavy, aching, bursting character, and is generally brought on by the heat of bed, by the dependent posture, and by motion. These symptoms are coeval with the changes in the bone. In the course of time, the pain is followed by a swelling, which at first is firm, hard, and unyielding, and seems to depend on enlargement of the bone; but this is not really the case, for expansion of the shell of the bone rarely, if ever, occurs in this disease. On this subject Professor Samuel Cooper remarks "It was formerly a common notion that in white swellings the heads of the bones were always enlarged; Mr. Russell, I believe, is the first writer who expressed an opposite sentiment, that he has never heard of an instance in which the tibia was enlarged from an attack of white swelling. The inaccuracy of the opinion was afterwards pointed out by Mr. Lawrence to the late Mr. Crowther, and the subject was mentioned in the earliest edition of the 'First Lines of the Practice of Surgery.'

"Deceived by the feeling of many diseased joints, and influenced by general opinion, I once supposed there was general, or regular expansion of the heads of scrofulous bones. But excepting occasional enlargement which arises from spiculæ of bony matter deposited on the outside of the tibia, ulna, &c., and which enlargement cannot be called an expansion of those bones, for a long time I never met with the head of a bone enlarged in consequence of the disease known by the name of white swelling. I was formerly much in the habit of inspecting the state of the numerous diseased joints, which were every year amputated at St. Bartholomew's Hospital, and though I was long attentive to this point, my searches after a really enlarged scrofulous bone always proved in vain, nor was there, at that period, any specimen of an expanded head of a scrofulous bone in Mr. Abernethy's museum."

In those instances in which real enlargement of the head of a bone has been found, the disease did not originate in tubercular degeneration of its cancellous texture. In the next stage, the pain is throbbing and extends over the whole articulation, and the swelling is no longer confined to the situation of the bone, but is general over the whole joint, and presents the character of fluctuation. These symptoms are coeval with the inflammation of the synovial membrane. Ultimately the skin becomes tense, white and glistening, and is marked with dilated tortuous veins; and the inflammation extending to the superimposed soft tissues, often gives an cedematous character to the swelling. The disease has already advanced to suppuration, and the matter, together with the debris of the bone, may be discharged through ulcerated apertures. At first, there is little constitutional disturbance. After some time, inflammatory fever comes on, and is ultimately succeeded by hectic. This, like other varieties of scrofulous disease, is most incidental to young persons, and usually occurs before the age of puberty; and although it has occasionally been found in persons in the middle period of life, yet it very rarely attacks any one after thirty years of age, who has not previously been the subject of scrofulous disease.

Treatment.—In this, as in all scrofulous diseases, the local affection is very much influenced by the state of the general health, the improvement and maintenance of which becomes therefore of paramount importance. The formation of the cheese-like deposit in the cancellated structure of the bone takes place at an early period, and the conditions most favourable to its formation are believed to be, the scrofulous diathesis, and a weak state of the general health. It is often found in persons of that habit who have been confined to situations where the air is impure, cold, or damp; who have been excluded from free exposure to the light of the sun; who have lived on a diet not sufficiently nutritious, who have not enjoyed regular exercise and fresh air; or who have been subjected to any cause of debility. If the presence of the deposit be suspected, the endeavour must be made to limit its extent, and to delay the suppuration by removing the patient from the exciting causes of the unhealthy secretion. For that purpose free exposure in the open air, generous diet, the use of cod-liver oil, attention to the state of the skin, and the use of such medicines as, from the particular state of the patient, are most likely to improve the general health, must

be strictly enjoined. A complete change of air, scene, and mental occupation, by improving the general health, is often found to produce the most beneficial effect on the local affection; and, on the same principle, a change of residence to the sea-side, from the bracing air there to be found, has often been observed to lead to very favourable results. Tonic medicines, and more especially the preparations of iron, are useful; but as permanent strength can be gained only by the proper assimilation of nutriment, those medicines are most likely to be useful, which, from the particular state of the patient, are most calculated to fit the digestive apparatus for the proper performance of its functions. As a tonic and alterative, I have often prescribed, and apparently with advantage, the iodide of iron. Of the preparations of iron, the *vinum ferri* of the old *Pharmacopœia*, and the saccharated carbonate of iron, are forms often used in such cases. These means for improving the general health will be found most effectual for limiting the cheese-like deposit, and preventing and repressing inflammation; for in this, as in all scrofulous diseases, more benefit may be expected from constitutional than from local treatment.

For facilitating the description of the local treatment, the disease may be considered in three different stages:—

1. When it is confined to the bone;
2. When it extends into the articulation;
3. When the abscess bursts.

In *all* these stages, rest is an important part of the treatment.

In the first stage, the indications to be fulfilled are—to limit the disease, and prevent its extending into the joint. With this view, in addition to rest of the limb, cold applications are sometimes employed with advantage. Depletion by leeches, and counter-irritants, are at times necessary, but the employment of depletion forms no prominent part of the treatment. In this stage I have frequently prescribed leeches, when, from any circumstance, there seemed to be a fresh accession of inflammation, and the apparent result has been to relieve, for the time, the urgency of the symptoms; but beyond this, I have never been sensible of any advantage, and in no case have I ventured on the practice but with reluctance. It ought always to be remembered that depletion has less influence in scrofulous than in common inflammation; and that if carried so far as to produce an impression on the general health, it increases the danger of the local affection. Mild counter-irritation, to an extent not to affect the general health, may, in general, be resorted to with advantage.

In the second stage, rest, with warm emollient applications, as poultices and fomentations, are the local remedies most likely to give relief.

In the third stage, rest is necessary, lest any of Nature's attempts at ankylosis should be frustrated. Pressure should also be employed so far as to diminish the size of the sinuses, without obstructing the discharge of the purulent matter. If the disease continue to advance, and the hectic fever be to such an extent as to endanger life, amputation may be necessary; but before determining on this step, the state of the internal organs should be carefully examined, with the view more especially of ascertaining whether or not the patient be free from pulmonary and mesenteric disease; for it may be found that the tubercular dege-

neration is general, and, if so, there is but little probability that an operation would be followed by recovery.

MORBUS COXARIUS, OR SCROFULOUS DISEASE OF HIP JOINT.

This disease, most commonly affecting children and individuals under the age of puberty, is occasionally though rarely met with at a later period. It forms the great majority of cases of hip joint disease in children, and begins in the cancellated structure; whereas the disease of the hip joint usually met with after puberty, and most common between that period and the thirty-fifth year, of which a description has already been given, is believed to commence with destruction of the articular cartilages. As the symptoms of this disease are, with certain exceptions which will be afterwards stated, the same as those of the disease of the hip joint beginning in the cartilages, and as the morbid changes are of the same nature as those of scrofulous disease of joints in which the bone is primarily affected—this being an example of that form of disease in the hip,—it will not be necessary to give so lengthened a description of certain points, as would otherwise have been requisite.

Symptoms.—These have been divided by some authors into two stages, by Ford and others into three, and some have arranged them into four stages or periods, the first being what they call the period of invasion. In the following description we shall divide them into three stages.

First Stage.—This, like some other scrofulous diseases, is of so insidious a nature, that often it has made considerable progress before its existence is suspected, the patient complaining for a long time merely of weakness and weariness of the limb, with uneasiness at the knee, but without any pain at the hip. This absence of pain in the affected joint has, in some instances, led unwary practitioners to mistake the seat of the disease. With these symptoms, there is a halt or slight limping in walking, and if the extremity be examined at this period, it will be found that the hip is flattened by the wasting of the glutei muscles, the limb emaciated, and the affected extremity elongated; which last phenomenon arises, as is explained by Hunter, from the pelvis being lower on the diseased side, in consequence of the patient supporting the body on the sound limb. As the disease advances, there is usually pain in the hip joint, though by no means so great as in the disease originating in the cartilage;—in some instances it is inconsiderable when compared with the pain at the knee. The explanation of the pain at the knee has been given in the section on destruction of the cartilages of the hip joint. Before the termination of this stage, there is a sense of tension in the groin, and the lymphatic glands in that situation usually begin to swell.

Second Stage.—The pain at the knee is much increased, and is almost always considerably greater than at the hip, but in the last-mentioned situation only, is it increased on pressure, which is an excellent guide to the seat of the disease. There is pain at the hip joint on concussion produced by striking the trochanter, the knee, or the sole of the foot.

The pain is much aggravated by motion; the patient supports his body entirely on the sound limb; the motions of the joint are impeded, so that flexion and extension cannot be carried to their natural extent, and there is also limitation of rotation, especially of rotation inwards, any attempt at which gives rise to great pain. Forcible abduction also causes pain at the hip. There is considerable swelling about the upper part of the thigh, together with the other symptoms, namely, flattening of the hip and its consequent unnaturally broad appearance; a lower position of the trochanter and fold of the hip, than on the sound side; wasting of the limb, and apparent elongation of the extremity. Some surgeons state that real elongation takes place in this stage; but for my own part, though I have given particular attention to this point, I have in every instance found the elongation seeming, and not real. By those who believe the elongation to be real, various explanations have been offered. Some suppose that, from the relaxation of the muscles and ligaments, the thigh bone is partially expelled from its socket, and so falls down; others, that the under part of the acetabulum being destroyed, it thus becomes wider, and the muscles relaxed; while others think that the under part of the acetabulum and part of the head of the femur are simultaneously destroyed. I believe, however, that, in every instance, the lengthening will be found to be only apparent, and that if the patient be placed in a horizontal position, and a careful examination be made of the measurements between corresponding points of the pelvis and extremities, they will be precisely the same on both sides of the body. With alteration of the position of the pelvis, there is often found lateral curvature of the spine.

Third Stage.—In this stage, the swelling is larger and more painful, it presents the character of fluctuation, and ultimately breaks, the matter which continues to be discharged being of an unhealthy character, and indicating carious destruction. Sometimes the abscess, instead of appearing on the thigh, has made its way into the pelvis through an opening occasioned by the destruction of the bottom of the acetabulum; in some cases it has burst into the vagina, and in others into the rectum; and occasionally it has been found to be discharged into the pelvis, and thence to escape through the ischiatic notch. The appearance of an abscess is always an extremely unfavourable symptom. In this stage, the extremity becomes really shortened, either, as in the disease originating in the cartilage, from destruction of the margin of the acetabulum, whereby the cavity becomes shallower and wider, so as to admit of the limb being drawn up, or from this condition combined with destruction of the head of the femur, or from actual dislocation. The shortening is sometimes sudden, but more frequently gradual. When dislocation takes place,—which, however, is not always the case,—the head of the femur is usually, although not invariably, drawn upwards and outwards upon the dorsum of the ilium. In this case the trochanter major is drawn upwards near the crest of the ilium, and the hip is protuberant, the swelling being produced by the upper extremity of the femur, and the muscles which are raised up by it. The wasted condition of the limb makes the swelling appear greater than it really is. The head of the bone has been found, although very rarely indeed, dis-

placed in other directions; namely, backwards, towards the ischiatic notch; forwards, upon the pubes; and downwards and inwards in the direction of the foramen ovale, when the extremity has been found

Fig. 109.



everted and elongated. There is a tendency to flexion of the thigh, which increases as the disease advances, and the foot is at last affected with oedematous swelling.

With regard to the direction of the toes; I have sometimes found them inverted in the early stage, but much more frequently everted, so that, judging from my own personal observation, I consider slight eversion to be their usual position in this stage; and after shortening has taken place, I have seen them sometimes still everted, with the foot directed nearly as it is in fracture of the neck of the thigh-bone, but much more frequently turned inwards, as in dislocation on the dorsum of the ilium. According to some authorities, when the destructive process is chiefly confined to the acetabulum, the head of the bone being comparatively little affected, the toes will be rotated inwards; whereas when the head of the femur is partially destroyed, the mechanical resistance to the action of the powerful rotators outwards is in a measure

Fig. 109. Drawing exhibiting the great shortening of the limb, and the alteration in the form of the hip, in the advanced stage of Morbus Coxarius, subsequent to spontaneous dislocation. From a patient in my surgical wards at the hospital.

removed, and eversion is the consequence. The age of the patient is to a certain extent a guide to assist in distinguishing this disease from that which commences in destruction of the cartilages, but the less degree of pain in this disease is the principal distinction. In a very few instances Sir Benjamin Brodie found, in the most advanced stage, that, owing to a portion of bone having exfoliated so as to be loose in the cavity of the joint, the soft parts were so greatly irritated as to occasion constant suffering. The general health is at first but little affected; after some time, slight symptoms of inflammatory fever may supervene; but the formation of abscess is followed by hectic, and its usual train of consequences.

Morbid Changes.—Opportunities of making dissections in the third stage are unfortunately numerous;

Fig. 110.



but as in that stage the whole articular apparatus is involved, it is impossible at that period to discover by dissection which structure was primarily affected. Opportunities of examining the state of the parts in early stages are not numerous, being only met with in those persons who have died of other diseases after the hip joint had become affected. From examinations, however, which have been made in such circumstances, there is reason to conclude that this disease begins in the bone—that the morbid changes are

conclude that this disease begins in the bone—that the morbid changes are

Fig. 111.



Fig. 112.



of the nature described in the section on scrofulous disease of joints

Figs. 110, 111, 112. Every stage of Morbus Coxarius, exhibiting tubercular deposit in the substance of the bone forming the acetabulum, and in the head of the femur. On the articular surfaces of both bones various irregularities and hollows are observed leading to masses of the deposit. The patient died of inflammation of the brain, which afforded an opportunity of verifying the diagnosis made during life. From preparations in my museum.

beginning in the cancellated structure—that in the majority of cases the os innominatum is primarily and most extensively affected—that it sometimes begins in the femur, and that occasionally the morbid action commences contemporaneously in both bones. The first deviation from the healthy condition is, that, according to Brodie, part of the cancellated structure becomes preternaturally vascular—that at an early period the affected part becomes unusually soft from a deficient proportion of earthy matter, and then a thin fluid is deposited in the cancelli. These changes constitute the anatomical characters at an early period of the disease. As the disease advances, the bone becomes still softer, and, instead of a thin fluid, a cheese-like substance is deposited in the cancelli, and, in many instances all traces of cancellous structure disappear, its place being occupied by the cheese-like substance, as several beautiful specimens in my own collection demonstrate. According to the views now entertained, the scrofulous deposit may be the result of previous perversion of nutrition, or a transformation of liquor sanguinis, exuded in consequence of a slight grade of the inflammatory process. In the progress of the disease, the structures between the deposit and the joint undoubtedly become involved in a process of inflammation; and as a result of this, a communication is established with the cavity of the articulation, and the whole articular surface becomes the subject of the morbid changes described in the section on scrofulous diseases of the joints beginning in the cancellous structure, which changes it is unnecessary here to repeat. That an inflammatory process occurs in the progress of the disease, all agree; but as to the nature of the morbid action of which the cheese-like deposit is a result, there has been a difference of opinion. Sir Benjamin Brodie, Lloyd, Rust, and others, regard the deposit as a product of inflammation, while others think it may be a result of perverted nutrition or secretion unconnected with inflammation, or a transformation of liquor sanguinis exuded in consequence of inflammation.

From many facts which have been ascertained, there seems reason to conclude, that in scrofulous constitutions, tubercular deposits in certain textures are results of inflammation, and their increase may be arrested if the inflammation be subdued; but it seems equally certain from many observations, and from the history of many cases, that when the constitutional diathesis is very decided, they may take place wherever there is any congestion of blood, and even sometimes where there is no trace whatever of any congestion, inflammation, or any disturbance of the circulation. In a practical point of view, this is not a matter of very great importance to determine with reference to the cheese-like substance in this disease: for it is generally allowed that depletion has less control over scrofulous than over common inflammation; that when adopted to any great extent in persons of a scrofulous diathesis, it is very injurious; and further, that even if the first deviation from a healthy condition were a consequence of a low grade of inflammation, it could scarcely be expected that the inflammation within the bone could be much affected by any extent of depletion, which it would be safe or judicious to allow. The scrofulous diathesis of the individuals in whom these depositions occur, is no doubt hereditary, and is believed to

depend, in part at least, on a peculiarity in the condition of the blood. The tendency to these depositions is increased by habitual low diet, deficiency of fresh air and exercise, residence in a low damp situation, want of free exposure to the light of the sun, debility from great evacuations or other causes, disorder of the organs of digestion, and habitual mental depression.

These considerations are important in a practical point of view, and show how needful it is for individuals who have a tendency to these depositions, to pay attention to diet, to live in a dry bracing atmosphere, with exposure to the light of the sun,—to be careful as to the proper regulation of the digestive apparatus, and to cultivate habitual cheerfulness. When the blood is morbidly defective of fibrine, exudation of albuminous matter seems very apt to take place on the occurrence of local congestion or inflammation; and in many instances it has been found even where no trace whatever exists of any disturbance of circulation. I have, in my own collection, many specimens in which bones are almost entirely filled with cheese-like deposit, where the outer encasement of bone is very thin, and no trace whatever discoverable of increased vascularity, but quite the contrary. The diminution of vascularity, after the occurrence of deposit, has been remarked by others.

Treatment.—After what has been already stated regarding the treatment of disease of joints, beginning in the cancellated structure, it seems unnecessary to give any lengthened remarks on the treatment of morbus coxarius. As the maintenance of the general health is a paramount indication, every judicious and available means for that object, consistent with the fulfilment of other necessary indications, must be adopted, their use being modified according to the particular circumstances of the case. The feeble state of the patient's constitution will scarcely admit of antiphlogistic treatment; but antiphlogistic regimen may be necessary until the inflammatory symptoms have been subdued. "Local abstraction of blood," Mr. Liston remarks, "is seldom at all required, and its employment in cases of morbus coxarius in weak constitutions, which it generally seizes upon, is very questionable." The most important parts of the local treatment are, the strict observance of rest, and the employment of counter-irritation; for which latter purpose blisters, setons, issues, moxa, the potential and the actual cautery, have all been used. We find that in the time of Hippocrates, counter-irritation by the actual cautery, was employed in this disease, and in modern times some consider it preferable to other means. For my own part, I have followed the method recommended by Sir Benjamin Brodie in disease of the hip-joint, namely, the employment of blisters in children and issues in adults, which he makes by the application of the potential cautery, and keeps open by repeatedly touching the issue with caustic.

The best situations for issues are the hollow between the trochanter major and the tuberosity of the ischium, and the outside of the joint near the situation of the tensor vaginæ femoris. Issues ought never to be employed to such an extent as to be a cause of debility, and they should be at once discontinued on the appearance of undoubted signs

of the existence of abscess. In recent cases, blisters usually give considerable relief. With regard to the treatment of abscess in this disease, much difference of opinion prevails. Some surgeons, thinking that the urgent symptoms of hectic come on more quickly when an opening is made than when the abscess is opened by nature, do not approve of making an opening, except when there is uncontrollable pain, with great tension of the soft parts; some recommend that an opening be made at an early period; while others advise that unless there be great constitutional disturbance, it be deferred until the soft parts become thin in consequence of interstitial absorption. When it is evident that matter has formed, and is beginning to make its way to the surface, it appears to be the preferable plan, on the whole, to make an incision, by which means considerable suffering may be prevented, and the extent of disorganization limited. On this subject Sir Benjamin Brodie remarks:—"An abscess connected with any joint, but particularly one connected with the hip, does not form a regular cavity, but usually makes numerous and circuitous sinuses in the interstices of the muscles, tendons, and cellular tissue, before it presents itself under the integuments. It is, therefore, less easy to evacuate its contents, than those of an ordinary lumbar abscess, and, indeed, it can seldom be emptied without handling and compressing the limb, in order to press the matter out of the sinuses in which it lodges. But this is often attended with very ill consequences. Inflammation takes place of the cyst of the abscess, and pus is again very rapidly accumulated. Small blood-vessels give way on its inner surface, the bloody discharge of which, mixed with the newly-secreted pus, goes into putrefaction, and exceedingly disturbs the general system. I have seen cases where, after a good deal of pains taken to obtain the complete evacuation of the contents of the abscess, and the puncture having healed, in a few days the tumour has become as large as ever, attended with pain in the limb, and a fever resembling typhus in its character, and threatening the life of the patient. A second puncture having been made, a quantity of putrid foetid pus, of a reddish brown colour, has escaped; the confinement of which had produced all the bad symptoms, which have been immediately relieved by its evacuation. The practice which has appeared to me to be on the whole the best, is the following:—An opening having been made with an abscess lancet, the limb may be wrapped up in a flannel wrung out of hot water, and this may be continued as long as the matter continues to flow of itself. In some instances, after a short time the discharge ceases, the orifice heals, and the puncture may then be repeated some time afterwards; but when the puncture has not become closed, I have never found any ill consequences to arise from its remaining open. On the contrary, I have no doubt that it is desirable that the wound should not heal, until the abscess has contracted, granulated, and healed from the bottom; and this is one reason for making, not a small puncture, but a free opening with an abscess lancet, or double-edged scalpel. Another reason for proceeding in this manner is, that when the puncture is small, the abscess cannot discharge the whole of its contents. Wherever this happens, the suppuration is much greater than it would have been, if

the matter could have flowed out as fast as it was secreted. A profuse discharge from an abscess is an almost certain indication that there is a lodgment of matter in some part of its cavity. Such a lodgment produces an effect on the secreting surface of an abscess, similar to that which a pea produces in an issue, and it should, if possible, be prevented."

[ANCHYLOSIS.]

Anchylolysis is a term now used to imply stiffness of the joint without reference to the limb being straight or bent, though the word *αγκύλωση* signifies crooked.

The forms of this affection are various, and numerous divisions may be made, based upon different conditions of the joint. The immobility may be partial or complete; it may depend upon changes which have taken place either in the soft parts or in the bone; it may be that these changes have taken place either within or without the capsule of the joint.

False anchylolysis is that stiffness resulting from changes in the soft parts, particularly in the fascia, tendons, and ligaments. It is often induced by keeping the joint at rest for a long time, as is frequently the case after injuries.

Inflammation in the neighbourhood of the joint is, however, a more frequent cause. Effusion of lymph takes place either in the superficial or deeper structures of the joint, and agglutination necessarily follows.

True anchylolysis is generally the result of some disease within the capsule of the joint, commencing in the synovial membrane or cartilage. The stiffness is complete, and is owing to a fusion of the articular extremities of the bones, which occurrence is often favourably considered by the surgeon, especially if not attended with curvature, since it indicates a termination of the original disease.

Rest is also a cause of true anchylolysis, and this principle is constantly employed in the treatment of those diseases, where the cure is dependent on fusion of the bones, for instance in coxalgia (see Fig. 108), and caries of the spine.

Treatment.—The mode of treatment will in a great measure depend upon the nature of the affection.

In cases of false anchylolysis, attended with bending of the limb, passive motion must first be attempted, but if no motion can be produced, machinery must be resorted to. Dr. Mütter's splint, a modification of Stromeyer's screw, will be found a most effectual means of making gradual extension and flexion.

In the application of this or any other mechanical means, care must be taken that the extension be very gradual, for fear of exciting inflammation. The screw should be turned a few

Fig. 118.



threads every day, until the limb is straightened, after which its action must be reversed, and the limb brought back to its original position. Flexion and extension should be made every day, and the joint should be rubbed with stimulating liniments. In addition to friction, benefit will also be derived from steam or vapour baths.

But should these means prove unavailing, and the rigidity seem to be dependent upon one or more tendons, they may be divided by a narrow-bladed knife subcutaneously.

In making the incision, the knife should be so directed as not to cut any important nerve or blood-vessel. After the division, extension is to be made with splints, and gradually increased from day to day, by means of the screw.

In cases of true or bony ankylosis no treatment will be necessary, unless the union of the bones is so angular as to deprive the patient of the use of an important limb. In such cases the operation of Dr. J. Rhea Barton is to be performed. It consists in sawing out a wedge-shaped piece of bone, and establishing a false joint, or if that should fail, reunion is to be effected with the bone in an extended position. Dr. Barton successfully performed this operation at the hip in 1827, and on the knee in 1838. Dr. Gibson, of the University of Pennsylvania, has also successfully performed the operation at the knee.

HYSTERICAL AFFECTION OF THE JOINTS.

Hysterical females often complain of great pain in the joints, which might be mistaken for some real and dangerous disease of the part. According to Brodie, "At first there is a pain referred to the hip, knee, or some other joint, without any evident tumefaction; the pain soon becomes very severe, and by degrees a puffy swelling takes place, in consequence of some degree of serous effusion into the cells of the cellular texture. The swelling is diffused, and in most instances trifling; but it varies in degree; and I have known, where the pain has been referred to the hip, the whole of the limb to be visibly enlarged from the crista of the ilium to the knee. There is always exceeding tenderness, connected with which, however, we may observe this remarkable circumstance, that gently touching the integuments in such a way as that the pressure cannot affect the deep-seated parts, will often be productive of much more pain than the handling of the limb in a more rude and careless manner. In one instance where there was this nervous affection of the knee, immediately below the joint, there was an actual loss of the natural sensibility; the numbness occupying the space of two or three inches in the middle of the leg. Persons who labour under this disease are generally liable to other complaints, and in all cases the symptoms appear to be aggravated, and kept up by being made the subject of constant anxiety and attention."

Treatment.—Unfortunately for the patient, this affection is sometimes treated for a diseased or injured joint by antiphlogistic measures, which necessarily aggravate the symptoms. Constitutional remedies are those to be relied on. All of the functions are to be restored to a healthy condition, particularly the menstrual and digestive, since these will be usually found at fault.

Hygienic remedies are more valuable than local. "The patient should have fresh air, generous living, and plenty of occupation for mind and body; she should be encouraged to take exercise, notwithstanding pain and weakness; and to resume, as far as possible, the habits of a healthy person." The shower-bath and frictions of the skin will improve the capillary circulation. Tonics, such as quinine, valerian, and iron, will be found most valuable where there is debility. Brodie has also found benefit in the use of assafoetida injections, and in the enveloping the joint with a plaster composed of equal parts of extract of belladonna and soap plaster.—ED.]

CHAPTER X.

CURVATURES OF THE SPINE.

ALL curvatures of the spine may be comprehended under one or other of the three following heads:—

I. That in which the spine presents some unnatural curvature either backwards or forwards;

II. That in which there is an unusual deviation from the mesial line, forming one or other of the varieties of mesial curvature;

III. That in which there is a combination of both the preceding conditions, which is denominated mixed curvature.

The curvatures of the first class are subdivided into three varieties:—

1st. Angular curvature;

2d. Posterior curvature, or excurvation;

3d. Anterior curvature, or incurvation.

Some authors confound the terms excurvation and incurvation.

ANGULAR CURVATURE.

Though Mr. Liston says—"the lumbar vertebræ are those most frequently affected," most authorities agree with Stafford in the opinion that this disease appears most frequently in the dorsal region. "Angular curvature," Mr. Stafford remarks, "may occur in any part of the vertebral column, in the cervical, the dorsal, and the lumbar vertebræ. It, however, most frequently takes place in the dorsal vertebræ, as they, from the manner in which they are impacted together with their cartilages, which are much thinner in front than behind, and from their natural inclination to bend forward, are more favourable to it than any other part of the spine; hence, disease of the cervical or lumbar vertebræ may go on to a considerable extent before curvature forwards will take place, the reverse arrangement of the cartilages occurring, and these parts of the column naturally bending backwards, whilst disease in the dorsal vertebræ, from the weight of the trunk being particularly upon them, and the curve being forwards naturally, would proceed more rapidly." All agree that the progress of the disease is most rapid, and its appearance earliest in the dorsal vertebræ; for in the cervical and lumbar regions the vertebræ and intervertebral substances are deeper before than behind, the reverse of which is true of the dorsal regions. In the former, therefore, very considerable destruction must take place before the spine can lose its natural convexity in front and become con-

¹ Stafford's Treatise on the Spine, p. 164.

cave; but in the latter, the spine being naturally concave in front, angular curvature will be produced by a destruction much less extensive than in the cervical and lumbar regions, but especially the lumbar. This form of curvature is more frequent in the cervical than in the lumbar region, and more frequent in the dorsal than in the cervical. It may occur at any period of life, though it is much more commonly met with in young persons, and seldom commences after the age of puberty, except when induced by some particular disease.

In treating of many injuries and diseases, we have considered first the causes, next the symptoms, then the state of the parts, and lastly the treatment to be employed; we shall here adopt a somewhat different arrangement, and refer first to

The state of the Parts.—Angular curvature may arise from one or other of the five following causes:—

I. It may be the consequence of scrofulous caries of the spine. The bodies of the vertebrae, from their spongy texture, are peculiarly liable to this disease. It is unnecessary to trace the progress, or explain minutely the nature of the local changes which precede the occurrence of scrofulous caries. According to some authorities, the first deviation from the healthy condition is, that part of the cancellated structure becomes preternaturally vascular; that at an early period the affected part becomes unusually soft from a deficient proportion of earthy matter, and that a thin fluid is deposited in the cancelli. These changes constitute the anatomical characters at an early period of the disease. As the disease advances, the bone becomes still softer, and instead of a thin fluid, a cheese-like substance is deposited in the cancelli. Sometimes the substance occupies only the cells, while the cancellous structure still remains; sometimes the cancellous structure of a part of the bone is removed, and its place occupied by the scrofulous substance, and sometimes the whole of the cancellated structure of a vertebra has been found to be absorbed, and caseous matter deposited in its stead. I have in my own collection a vertebra, the whole cancellated structure of which has been absorbed, and replaced by cheese-like matter retained in its place by an exceedingly thin shell of bone. This variety, in the quantity and extent of deposit, corresponds with what is observed in other bones affected with this disease. When the disease, for example, is situated at the joint ends of bones, the deposit is usually very limited; but in a long bone the same substance is sometimes found to occupy the whole of its interior. I have specimens in which the whole of the femur is occupied with this substance, contained within a very thin encasement, which is formed by the outer part of the original shell of the bone. That an inflammatory process occurs in the progress of the disease all agree; but as to the nature of the morbid action of which the caseous substance is the result, there is a difference of opinion. According to the views now entertained, the scrofulous deposit may be the result of previous perversion of nutrition, or a transformation of liquor sanguinis exacted in consequence of a slight grade of the inflammatory process.

From many facts which have been ascertained, there seems reason to conclude that in scrofulous constitutions, caseous deposits in certain

textures are results of inflammation, and their increase may be arrested if the inflammation be subdued; but it seems equally certain from many observations, and from the history of many cases, that when the constitutional diathesis is very decided, they may take place wherever there is any congestion of blood, and even sometimes, where there is no trace whatever of any congestion, inflammation, or any disturbance of the circulation. In a practical point of view, this is not a matter of very great importance to determine, with reference to the cheese-like substance in this disease; for it is generally allowed that depletion has less control over scrofulous, than over common inflammation, that when adopted to any great extent in persons of a scrofulous diathesis, it is very injurious; and further, that even if the first deviation from a healthy condition were a consequence of a low grade of inflammation, it could scarcely be expected that the inflammation within the bone could be much affected by any extent of depletion, which it would be safe or judicious to institute. The tendency to this deposit is believed to depend, in part at least, on a peculiarity in the condition of the blood, which is unusually serous. When the blood is morbidly defective of fibrine, exudation of albuminous matter seems very apt to take place on the occurrence of local congestion, or inflammation; and in many instances it has been found, even where no trace whatever exists of any disturbance of circulation. I have, in my own collection, many specimens in which bones are almost entirely filled with the caseous deposit, where the outer encasement of the bone is very thin, and no trace whatever discoverable of increased vascularity, but quite the contrary. The diminution of vascularity, after the occurrence of deposit, has been remarked by others.

The deposition is succeeded by a low grade of inflammation of the bones and intervertebral substances, which ultimately terminates in caries; and, in consequence of destruction of the bodies of the vertebræ, as well as of the intervertebral substances, the sound part, above the portion destroyed, falls forward on the part below, and thus gives rise to angular curvature. The commencement of the destruction is almost invariably towards the anterior parts of the bodies of the vertebræ, but sometimes, though very rarely, on their posterior aspect; in this case the parts which naturally furnish attachment to the arches are destroyed, and a separation takes place between them and the remaining portions of the bodies of the vertebræ. In my own collection there is a particularly interesting preparation illustrative of this fact. In this preparation, destruction has taken place of the posterior surfaces of the bodies of certain vertebræ, so that the arches and transverse processes are detached, the anterior portions of the bodies remaining entire. There is no breach of continuity along the front of the column, but there is a large chasm in its posterior portion, communicating with the vertebral canal. There was no curvature in this case; for the anterior parts of the vertebræ being entire, there could not have been angular curvature with the projecting angle backwards, nor could there have been angular curvature with the projection forwards; for, though the arches were detached from the bodies, the spinous processes and the arches remained

impacted together, and prevented the spine from presenting a concavity along its posterior aspect. There is considerable variety as to the relative position of the two extremities of the diseased portion; sometimes the upper part falling forward, comes to be directly in contact with the under part; sometimes it is otherwise; but this will depend upon the number of the bodies of the vertebræ destroyed, and the extent of the

Fig. 114.



Fig. 115.



destruction backwards. As the bodies of the vertebræ and the intervertebral substances form the part of the column which supports the superincumbent weight, when a chasm or gap is produced in front, the superincumbent weight sends the upper part forward, producing incurvation in front of the spine, and projections behind of the spinous processes, and, from the incurvation being of an angular form, the disease is denominated angular curvature. The spinal cord traverses the spinal canal, having its sheath in contact with the arches, and not the bodies of the vertebræ: that is to say, it directs its course along the greater curve. In most cases of decidedly marked angular curvature, complete or partial interruption of the functions of the spinal cord comes on sooner or later; the portion of the cord at the affected part of the spine is as far as possible from the bodies in front of it; but still, the bones do in some cases press upon the cord, and interrupt its functions, especially when the destruction has been rapid, and the curve is very abrupt. This cause of pressure and consequent paralysis may not be permanent. The projecting portions of bone may ultimately become smoothed down by absorption, and in some cases, this no doubt explains the discontinuance of the paralysis. The functions of the cord may also be interrupted by pressure upon the membranes, produced by matter formed in the progress of the disease. These are the causes, external to the membranes, which may occasion pressure on the cord and interrupt the due performance of its functions. The same interruption, however, is

Fig. 114. Remarkable example of angular curvature and ankylosis. From a preparation in my museum.

Fig. 115. Angular curvature from caries. From a preparation in my museum.

often produced by results of inflammation, with which the membranes or the cord, or sometimes both become affected; and in such cases there is usually found on dissection, a thickened condition of the membranes, or the formation of matter between or within them, or a preternaturally injected state of the cord, or a softened condition of it, which may vary in degree from a slight deviation from the healthy appearance, to that state in which it is almost entirely fluid. Paralysis, however, has been known to exist where none of the above conditions, nor any morbid alteration of structure, was discovered on dissection; and Stafford and others suppose that it is sometimes to be referred to longitudinal compression of the anterior portion of the medulla. "The effect of angular curvation," Mr. Stafford remarks, "is the bending of the medulla and its membranes; which, as I have before stated, causes a greater or less degree of paralysis of the parts below, which, however, does not always arise from pressure of the bones upon it, but from the bending of its own substance, producing pressure upon itself; for instance, the anterior portion of the medulla would be compressed, while the posterior portion or back of it would be stretched."

It may be regarded as a general law, that of the two functions, voluntary motion and sensation, the former is almost invariably first removed, and the latter first restored; the rationale of which is, that the anterior columns of the spinal cord, which give off the anterior roots of the nerves, by which they preside over voluntary motion, are nearer to the seat of the disease, and therefore more exposed to pressure than the posterior columns which give off the roots presiding over sensation. Although pressure on the spinal cord is usual in angular curvature, it is surprising how nature, even in some cases where the destruction is very great, and the deviation from the natural form of the spine very remarkable, yet continues to maintain the integrity of the vertebral canal, so as to preserve the cord from being compressed. Of many examples of this remarkable fact I shall only refer to the following: Mr. Stafford mentions the case of a child in whom, though the bodies of six dorsal vertebræ were destroyed, and the angle of the curve was very acute, paralysis did not occur. Professor Cruveilhier gives the particulars of a case in which the bodies of five dorsal vertebræ were completely destroyed; where the fifth dorsal vertebra rested on the eleventh, the two becoming ankylosed, and at a very acute angle; and yet the medulla was preserved free from pressure. I have at present under my care a girl ten years of age, in whose case the bodies of the fourth, fifth, sixth and seventh dorsal vertebræ must be entirely removed; an abscess is formed, and is pointing about the middle of the seventh rib; and judging from the appearance of the spine behind, the parts above and below the seat of the disease must be for a short distance almost parallel with one another, so abrupt is the curve; and still the patient is as yet quite free from any symptoms of compression of the spinal cord. The only explanation given of such cases is that the process of destruction must have been very slow, and the deviation from the natural form extremely gradual. Mr. Stafford remarks, "The completeness and incompleteness also of the symptoms very much depend upon the rapidity

with which the curve takes place. If the destruction of the bodies of the vertebræ has been very quickly effected, the paraplegia is usually more complete; but if it has been slow in its progress, the paralysis below is often very imperfect."

In the progress of the disease, a collection of purulent matter forms, as in scrofulous caries in other bones, constituting what in some instances has been denominated lumbar or psoas abscess, but more properly spinal abscess. The appearance of abscess is an exceedingly unpromising symptom; it is, indeed, generally regarded as fatal. The period at which suppuration takes place differs greatly in different examples of this disease; in some it occurs at an early period, in others not for many months, or even for a longer period; and indeed an abscess is sometimes retained for years by the neighbouring parts becoming thickened and matted together. As a general law it may be stated, that the suppuration is much earlier when the curvature is induced by scrofulous caries than when it arises from ulceration of the cartilages. The situations in which such collections point are various. When the abscess is connected with the cervical vertebræ, it may present itself among the muscles on the side of the neck, which is most usual, or it may be directed forwards, and burst into the pharynx, of which I have seen one example. When the abscess is connected with the dorsal division of the spine, it may present itself along the lateral part of the thorax, of which I have already mentioned one example, or it may point at other aspects of the parietes of the thorax by running along some of the intercostal spaces; but usually the matter follows the course of the posterior mediastinum, escapes under the diaphragm, and then descending along the course of the psoas muscle points in the groin. Sometimes an abscess in the dorsal division forms a large swelling on the side of the abdomen, the matter descending between the peritoneum and the other structures which constitute the abdominal parietes; and I had an opportunity of making a dissection in a case of curvature from scrofulous caries of the 7th, 8th, and 9th dorsal vertebræ, in which a spinal abscess, after following the course first of the mediastinum, and then of the psoas magnus, burst at last into the under extremity of the sigmoid flexure of the colon. When the abscess is connected with caries of the lumbar vertebræ, it most commonly points in the groin near the insertions of the psoas magnus and iliacus internus muscles, or somewhere in the thigh below Poupart's ligament. In some instances, the abscess has shown itself in the loins, and in others in the nates, but these are comparatively very rare occurrences. The only favourable termination which can take place in this disease is anchylosis, to which, however, the soft condition of the bones is by no means favourable.

II. Angular curvature may result from destruction of the intervertebral substances,—the disease thence extending to the bodies of the vertebræ.

III. It may arise from chronic inflammation commencing in the vertebræ, followed by ulceration and caries; the vertebræ being like other bones, liable to inflammation. Such inflammation may be of a common character causing common caries; or of a scrofulous character

producing scrofulous caries already referred to, or of a rheumatic character, which may end in what has been denominated rheumatic caries. Destruction of the intervertebral cartilages is believed to be an early consequence of inflammation of the bodies of the vertebræ.

IV. It may originate in the softening and absorption of a vertebra without the production of any chasm. I have in my collection two very striking specimens of this condition, in both of which the curve is very abrupt, and yet there is no chasm or any trace of inflammation discoverable; and I have had under my care for two years a girl with angular curvature in the middle of the dorsal region, which case, from the entire absence throughout of any symptom whatever, except the deviation from the natural form of the spine and the consequent alteration of the form of the chest, I consider to be one of this nature.

V. According to some surgeons, it may arise from inflammation of the investing membrane of the vertebræ. • Mr. Tuson, after referring to some of the more common causes of angular projection, says, "From observations I have made, and numerous cases which have come under my care, I have formed a conclusion, that it may also arise from inflammation commencing in the membrane that covers the upper and lower surfaces of the bodies of the vertebræ, connecting the intervertebral substances with the bone, and then extending itself into that substance and cancellated structure."

Symptoms.—These are divided into two stages:—

1st. Before curvature;

2d. During and after its formation.

In the first stage, the patient complains of a sense of weakness at the part of the back affected, and of weariness, and is unwilling to take exercise. After some time, a dull heavy pain is experienced during and after exercise. The pain, which at first is slight, becomes afterwards more severe, and is increased by exercise, by any sudden jerk communicated to the spine, and generally by percussion, and relieved by the horizontal position. From irritation of the spinal cord, there is often an altered sensation or occasional feeling of pain in the lower extremities; occasionally spasmodic twitches of the muscles, and at times spasmodic rigidity of the limbs. In the progress of the disease, and before the second stage, the muscles become wasted and lose the power of readily obeying the will, in consequence of which the patient cannot easily and quickly place his foot exactly on the spot where he may wish to place it; and when he walks he is very apt to trip. There is coldness of the extremities, and fulness and tightness in the epigastric region; patients in this state often complain of chilliness, and they are usually found to exhibit symptoms of a feeble condition of the general health. In the second stage there are found the local symptoms of the first stage, often in an increased degree, and together with these, curvature, at first slight, but gradually increasing, and in a form very abrupt,—a peculiarity most important to be remembered, as it is one of the best guides for distinguishing angular curvature from some curvatures which depend on a different condition, and in which, although the spine is bent backwards, the curve, instead of being abrupt and angular,

is gradual, resembling a segment of a circle. There is angular projec-

Fig. 116.



tion posteriorly of the spinous processes, and the spine is bent forwards in consequence of destruction of the bodies of the vertebræ which support the superincumbent weight.

As the disease advances, the patient usually loses all sensation and motion in the parts below the point of pressure on the spinal cord; in short, he becomes affected with a paraplegia; the power of motion being generally first lost, and last restored, as explained in describing the state of the parts. The patient loses control over the bladder and the sphincter of the rectum, so that the urine and fæces pass off involuntarily; or if the pressure on the cord be very great, there may be complete retention of the urine.

Slight difficulty of passing urine has often been found to be an early symptom. The easy performance of the functions of the digestive and respiratory organs is more or less interrupted; the bowels are generally constipated; and the patient complains of a sense of fulness and tightness at his stomach, and in many cases of pain. These conditions of the organs of digestion and respiration are supposed to be produced through the connexion between the spinal and ganglionic nerves; and this supposition is probably correct; but there can be no doubt that the function of respiration is often rendered difficult in curvature in some situations by pressure on the intercostal nerves, which are thereby rendered incapable of calling into action the intercostal muscles over which they preside, to assist in enlarging the chest in inspiration. To this point we shall afterwards have occasion to refer. In the progress of the disease abscess may appear, the situation where it shows itself varying, as formerly stated, according to the situation of the disease; its appearance is usually attended with increased derangement of the general health, and under the continuance of the discharge and irritation, hectic fever to a very urgent extent supervenes, and the bowels or some other internal organs becoming infected, death ensues. Such are in general the symptoms of angular curvature, but they differ considerably in different cases, particularly as to the local symptoms, which in some instances are as above described, while in others there is no pain or tenderness—the only local symptom being the deformity. If the deformity depend on mere absorption, there may be no pain, but it is an important fact which should always be kept in view, that scrofulous

Fig. 116. From a patient.

caries of the spine, as is mentioned by some authors, and as I have several times found, may run its course, and yet the patient may not experience any pain or any local symptom beyond a sense of weakness and weariness of the affected part. So little pain is there, that in many instances the curve has been formed before the real seat of the disease has been suspected. In scrofulous caries there is generally less pain than when the disease originates in destruction of the cartilages; but suppuration usually takes place earlier. These differences, the history of the case, and the presence or absence of a scrofulous diathesis, may assist us in forming some opinion; but we have no sure guide enabling us in the living body to arrive at a certain knowledge, whether the disease has originated in scrofulous caries of bones, or in destruction of intervertebral cartilages. The symptoms of curvature vary also according to the part of the spine affected. When it occurs in the lumbar region, and more especially towards its lower part, it is not usual, unless the disease be to a great extent, to find the altered sensations and spasmodic twitches in the early stage, or the paraplegia in the latter, as the great size and the form of the bodies render the contents of the canal less liable to pressure. When the curvature is in the dorsal region, the projection, owing to the great length of the spinous processes, becomes very marked, and the chest considerably altered in shape, being flattened laterally, the ribs projecting backwards, following the vertebræ with which they are connected, and the sternum appearing too far forwards. There is at times palpitation, and in some instances difficulty in breathing, occasioned by compression of the intercostal nerves, or of the spinal cord above their origins; but this symptom is not so frequent when the curvature is in the dorsal, as when it is in the cervical region. When it is in the cervical region, the head is bent forwards, the prominences behind are not large, unless the seventh cervical vertebra be involved, and the respiration is difficult. In the early stage, there may be pains and twitches of the muscles of the upper extremities as well as of other parts inferior to the seat of the disease. Sometimes when the disease is in the cervical region, especially in its upper part, it proves fatal by producing effusion in the brain, and in some cases the odontoid process having lost, in the progress of the disease, the attachments of the ligaments which keep it in its proper situation, presses on the spinal cord, and thereby causes immediate death, the seat of the pressure being higher up than the origins either of the phrenic or of the intercostal nerves which preside over the actions of the muscles of respiration. Having thus given a short account of the symptoms of angular curvature of the spine generally, and the additional symptoms peculiar to curvatures in particular situations, we shall next refer very briefly to the treatment.

Treatment.—Any attempt to remove the curvature would be most injudicious. Ankylosis is the only favourable termination to be hoped for, and therefore the object aimed at in treatment should be, to place the patient under the circumstances most likely to conduce to that result. With that view, it is indispensable, first, to keep the patient in a recumbent position, so as to remove from the diseased parts the pressure of the superimposed weight, and to preserve the parts as much

as possible in a state of perfect quietude in that position ; and secondly, to use all means, judicious and available in the circumstances of the case, for maintaining the general health. In some cases local remedies are highly beneficial.

That it is necessary to confine the patient to the recumbent position, does not admit of question, for it is evident that the superimposed weight pressing on the diseased part, must not only act as a source of irritation, but must also tend to increase the curvature ; and it can only be effectually removed by placing the body in the horizontal position. And that any effort which nature may make to effect anchylosis may not be defeated, it is further necessary that the parts should, as much as possible, be prevented from being moved upon each other. Another advantage which results from preserving the parts at perfect rest in the horizontal position is, that the removal of the irritation, caused by the superincumbent weight, from the diseased parts, diminishes the danger of the formation of abscess, which (as formerly stated) is a most unpromising occurrence, and must induce the gloomiest apprehensions as to the ultimate results. One of the best means for fulfilling the above indications is, to place the patient in the supine position on Earle's bed, which, besides other advantages, rendering it very convenient for this part of the treatment, allows the relative position of the trunk and limbs with regard to each other to be slightly changed, without any risk of moving the diseased parts on each other. The slight change thus allowed renders the confinement to the recumbent position much less irksome than otherwise it would be. As an additional precaution for preserving the diseased parts from any movement it is in many instances advisable to apply splints on each side of the spine. The splints in such cases must suit the shape of the parts to which they are applied. Some recommend the patient to be placed in the supine posture, but others give the preference to the prone position, because in that attitude the superimposed weight is more effectually removed,—there is no risk of heat and irritation from pressure,—it favours the return of venous blood from the bodies of the vertebræ,—and the approach of paralysis, it is thought, may be deferred, as matter will gravitate away from the medulla. This position is also very convenient when local applications are necessary, and in some cases the curve is so abrupt, that it is almost impossible with every precaution to keep the patient long on his back without producing irritation of the soft parts. But notwithstanding the above-mentioned advantages, I confess I have, in the majority of cases, found treatment conducted in the supine posture more satisfactory, and chiefly, I believe, from the diseased parts being more easily preserved in a state approaching to complete immunity from motion, than is possible when the treatment is conducted with the patient in the prone position, in which I have often been annoyed by finding it impossible to prevent the patient from moving the upper part of the spine by frequently moving the head and shoulders ; and as far as my experience goes, the supine position is preferred by patients. Rest, however, of the diseased parts, and the recumbent position, whether the body be prone or supine, are of the utmost importance from the very commencement of the disease, until a cure is effected by

anchylosis. When it is believed that anchylosis has taken place, and the patient is allowed to resume the erect attitude, it is a judicious precaution to employ for some time an apparatus, such as that generally known by the name of the spine supporter, for removing the superincumbent weight.

The maintenance of the general health is another and equally important indication, but unfortunately some of the best means for fulfilling it are not compatible with the rest and the recumbent position which form essential parts of judicious treatment. The great importance of attending to the general health must be evident, when it is considered under what circumstances scrofulous deposits are most apt to take place in bone. In individuals of a scrofulous diathesis, insufficient nutriment or clothing, living in a damp and cold or impure atmosphere, want of exposure to the sun's rays, mental depression, and any cause of debility acting permanently or habitually for a length of time, have unquestionably an influence in exciting scrofulous deposits in bone, as well as in other textures. These considerations suggest the necessity, especially in scrofulous cases, of a generous digestible diet, living in a pure dry atmosphere (the bracing air of the seaside being often highly beneficial), exposure to the light of the sun, the cultivation of habitual cheerfulness, the proper regulation of the digestive apparatus, and the use of such remedies as from the particular circumstances of the case are best calculated to improve the general health. The tonic medicines generally found most useful are the preparations of iron. But as far as medicine is concerned, I believe the most important point is, to have recourse to those remedies which, from the particular circumstances of the case, seem most likely to preserve the digestive organs in a proper state. Besides these means, in some cases, local remedies are necessary; but the employment of them will depend on the nature of the cause of the disease. If the disease depend upon scrofulous caries of the vertebræ, or upon softening with absorption without ulceration or caries, depletion would be worse than useless, and would tend to weaken the patient. In these cases, the surgeon must content himself with advising the recumbent position, maintaining the diseased parts in a state of quietude, and prescribing all suitable means for preserving the general health. In scrofulous caries, benefit will often be found to accrue from the early and very cautious employment of counter-irritation, along with the treatment here alluded to. If the curve arise from inflammation of the bodies of the vertebræ, of their investing membrane, or of the intervertebral cartilages, slight local depletion by leeching or cupping at the commencement of the disease, and afterwards counter-irritation, are known to be highly beneficial. The repeated application of small pieces of blister to each side of the vertebral column at the seat of the disease has been found well suited for children, and caustic issues for adults. Of the various means for producing counter-irritation, Mr. Pott gave the preference to caustic issues. I have used them very frequently, and in some instances with gratifying results. It is improper to produce a great discharge, which would tend to weaken the patient, and besides, the long continuance of a profuse discharge and of irritation might induce hectic fever. If abscesses form, the issues

should be discontinued. Mr. Pott, whose valuable works contain many cases of disease of the spine, attended with paralysis, successfully treated by the application of counter-irritants, was the first who pointed out to the profession the results of such practice, and many have since followed it with equal success. About two years ago I ceased to attend a patient, in whose case I was much gratified with the result of using caustic issues, together with rest and the recumbent posture; and I refer to the case as a striking example of the complete restoration of sensation and the power of motion of the lower limbs, after they had been for eighteen months considerably affected, and for eleven months entirely lost.

The patient, who was thirty years of age, had suffered for a considerable time from pain and a sense of weakness in his back; he afterwards became affected with angular curvature in the middle of the dorsal region, and after the usual train of symptoms, ultimately lost all sensation and power of moving the limbs. The power of motion was first lost, and sensation was first restored; but the loss of both sensation and motion was as complete as possible. When I first saw him, he had lost the use of his limbs for several months, and the curve was rather abrupt, and involved three of the dorsal vertebræ. After treatment had been employed for four months, the sensibility of the limbs began to return, and ultimately it became perfectly natural, and this was followed by a restoration of the power of motion; and for two years the patient has been in every respect perfectly well, without any remains of the disease except the curve. I am satisfied that anchylosis has taken place. The case is interesting, as affording a remarkable confirmation of the fact, that the functions of the spinal cord may be for a long period completely suspended, and yet afterwards perfectly restored.

Some have gone so far as to affirm, that issues and counter-irritants are of no use whatever in this disease; an assertion which can only be explained by the want of success consequent on their injudicious adoption.

POSTERIOR CURVATURE, OR EXCURVATION.

This distortion may be the consequence of scrofula, rickets, or molities ossium, or of common or specific inflammation affecting the spine, beginning sometimes in the bodies of the vertebræ, sometimes in the intervertebral substances; or it may arise from a softened condition of the spine, or from debility consequent on mesenteric disease, or from weakness of the muscular system, however induced, or from constantly or frequently keeping the spine in an improper attitude, as is the case with studious persons, who contract a habit of leaning over books, or with clerks who have not been careful to avoid stooping while writing, or with individuals belonging to certain trades, as printers, or watch-makers; or it may be, as is often observed in girls, a consequence of a careless manner of allowing the shoulders and arms to hang forward. But whatever may be the primary exciting cause, the curvature will in almost every instance depend,

1st. On general caries of the anterior surfaces of the bodies of many vertebræ, the result of either common or specific inflammation; or,

2d. On compression of the bodies of the vertebræ from softening; or,

3d. On weakness of the muscles that support the spine; or,

4th. On combinations of some of the preceding conditions.

Symptoms.—Either a part or the whole of the spine may be affected.

There is an unnatural rounded prominence on the back, the distinguishing peculiarity of which is the absence of that abruptness which is found in angular curvature. If the curve be situated in the cervical region, the chin falls towards the sternum, producing what is commonly called "the stoop."

When the whole spine is affected, forming a semicircular curve forwards, the patient, when sitting, is disposed to support his trunk, if the disease be not far advanced, by placing his hands upon his knees, and, if it have made considerable progress, by placing his elbows upon his knees; and when walking, he has an inclination to rest his hands on anything which he may be

passing, to enable him to bear up under the superincumbent weight, which becomes very overpowering. The local and general symptoms vary according to the state of the spine on which the curvature depends, and the condition of the body in which it takes place. From the gradual form of the curve, the functions of the cord are not interrupted.

Treatment.—In considering what kind of treatment is proper, the surgeon must be guided by the nature of the cause of the disease. If the distortion depend on general caries, then the same treatment as in angular curvature is suitable. If it occur as an effect of rickets, or syphilis, a most important part of the treatment consists in the employment of the remedies adapted for these constitutional diseases. When it arises either from a softened condition of the vertebral column itself, or from weakness of the muscles necessary for maintaining it in the erect position, the surgeon should endeavour, by strict attention to the general health of the patient, to invigorate his frame. To effect this, pure air—a saline atmosphere, especially in scrofulous individuals, is often beneficial—generous diet, wine, or any other stimulus that agrees with the patient, tonics, of which the preparations of iron will, in many

Fig. 117.



Fig. 117. Excurvation of spine. From Tuson.

cases, be found among the most useful, and sea-bathing, should be enjoined. If sea-bathing be inconvenient, salt ablutions, or sponging the body with salt water, may be substituted for it. The regular and daily use of friction by means of the hair-glove or flesh-brush, and exercise on foot, should also be adopted. The patient should never take so much exercise as to induce weariness, and he should afterwards assume the recumbent position, until he experiences an aptness or fitness for further exercise. The surgeon should also recommend friction, with some stimulating embrocation, all along the spine, and such amusements as tend to strengthen the muscles of the back. "When a case of stooping is confirmed," Mr. Stafford remarks, "a regular course of the gymnastic exercise is perhaps the best treatment that can be pursued. These, however, must be employed with great caution, as by their too violent use in the first instance, much mischief may arise. In simple cases, very simple means may be resorted to. One plan I am inclined to think would be attended by the greatest success, and which is, a weight being suspended from the shoulders and resting on the abdomen. My reason for thinking this is, from having observed in a regiment of soldiers that the one who carries the great drum is invariably the straightest man. For the reason just mentioned, it would be a good plan to make children play at soldiers, and let the one who is disposed to stoop carry the drum in the same manner as the drummer of a regiment. I have little hesitation in saying the habit would soon be cured. Another very good exercise, also, would be to make the individual play at cymbals; he would be forced to extend his arms in the air and look upwards, by which the head and trunk would be thrown backwards, whilst the muscles of the shoulders would be in constant action."

Mr. Stafford farther says:—"The use of the dumb bells would be found in some cases of great service; for instance, where the shoulders hang forward, by which the chest is narrowed, and the sternum is forced in by the clavicles; by their employment the shoulders would be thrown backwards, and the chest expanded. Other methods no doubt might be advised; as a general rule, however, any exercise which will bring the muscles of the back into action will be of great utility in this description of distortion."

In curvature depending upon caries of the spine nothing could be worse than these amusements; hence the importance of diagnosis. When the curvature arises from bad habits, as constantly leaning forward, allowing the shoulders and arms to hang forward, or from an employment in which the spine is bent forward, the habit must be corrected, and the employment which produced the curvature must for a time be discontinued. In this variety of curvature, mechanical support combined with a certain amount of exertion is sometimes useful. Large padded splints are by some applied to the sides of the abdomen, and secured by flannel bandages. Others employ a wooden shield, the concavity of which they apply to the convexity of the patient's back; gradually diminishing the concavity by placing in it another layer of flannel or some soft padding. These appliances should not be worn constantly, but for a short time each day. In the few cases where mechanical support during a part of the day is advisable, it may be given by more

elegant appliances than those referred to above; appliances which cannot confine the parts or induce injurious pressure in any way.

ANTERIOR CURVATURE, OR INCURVATION.

This, which happily is the rarest of all the curvatures of the spine, is remarkable for the rapidity with which it proceeds, when it has once commenced. It may happen as the consequence of rickets, mollities ossium, common or scrofulous inflammation beginning in the spine, and primarily affecting either its bones or softer textures; or, it may arise from a softened condition of the vertebral column, or from any state which so deranges the due balance in the action of the muscles maintaining the spine in its proper attitude, as to render the extensor muscles of the vertebral column too powerful for their antagonists.

The treatment consists in the application of the principles already laid down for the treatment of these particular conditions.

LATERAL CURVATURE.

This is by far the most common of all the curvatures of the spine, and is more frequently met with in girls than in boys, and in the children of the wealthy than in those of the poor, and much more frequently in the females of this climate than in those who live in warmer latitudes. It seldom commences after the age of puberty, except when induced by the excessive action of the muscles of one side. That girls are more liable to it than boys is, no doubt, owing to the serious defects in their physical education. The injudicious means adopted for improving the figure by preventing the proper play of the muscles of the trunk, by retarding the development of the bones and muscles, and by producing more or less absorption of them by compression, cannot but be highly injurious; and to these causes, aided by the want of proper exercise, and of sufficient exposure to the open air, is to be referred the frequency of this disease in girls,—causes which more frequently affect the wealthy than the middle and lower classes. The comparative rarity of lateral curvature as a primary form of disease among the poor, is proved by general experience, and by the statistical fact, that of thirty-two thousand nine hundred and ninety-one patients who presented themselves for relief at Middlesex Hospital in five years, there were not more than twenty affected with lateral curvature as a primary disease. As a secondary result arising from other affections, such as disease of the hip, or disease of the knee, lateral curvature is frequently found among the poorer classes. It seems to be the want of attention to this distinction which has induced some to question the fact of the comparatively rare occurrence of lateral curvature among the poor. The comparative exemption from this disease in the females of warm climates has been attributed to the loose clothing they are obliged to wear, allowing the due development of their various organs, to the want of stays, and of many injurious restraints, and to their not being subjected to the fatiguing confinement to an irksome position, as the young ladies of this country often are daily for many hours together, in acquiring a variety of accomplishments.

Causes.—The principal predisposing causes are rickets, mesenteric disease, a softened condition of the bones of the spine, compression of

the thorax from tight lacing, weakness, especially when consequent on measles, whooping-cough, or other infantile diseases, want of proper exercise and exposure in the open air, and any circumstance which acts unfavourably on the general system before the various organs have attained their full development. Tight lacing is not uncommonly a predisposing cause of distortion of the spine. This custom, restraining the actions of the muscles, prevents their natural development, so that they become attenuated; the bones also to a certain extent become diminished by absorption, and softened, so as to be unable to sustain the weight they were destined to support; and the cavity of the thorax is diminished, in consequence of which there is not sufficient room for the healthy and easy performance of the functions of the heart and lungs.

The immediate exciting causes are, the habit of standing on one leg, standing, sitting, or reclining in a position in which the spine is inclined too much to one side, injudicious confinement of a young person for a long time to one position without support to the back, the consequent weariness and irksomeness obliging the child to lean to one side to obtain relief, the disproportioned use of the muscles of one side, as in the case of persons engaged in certain avocations, or of children to obtain relief from the uneasy sensations caused by ill-made clothes, and lying on a soft bed with a very high pillow. These are the principal exciting causes of lateral curvature, and the rationale of their operation is sufficiently obvious.

When the distortion arises from the habit of standing on one leg, the first deviation from the proper shape of the spinal column takes place in the lumbar region, constituting what is termed the primary curve; and this will be followed by a curve in the dorsal region; which, to distinguish it from the former, is called the consecutive curve. If the convexity of the curve in the lumbar region be to the left side, that of the dorsal region will be to the right: so that if the distortion be to a great extent, the shape of the spine will somewhat resemble that of the letter S reversed: thus giving rise to the appearance of "growing out" of the right shoulder and left hip; but if the convexity of the curvature in the lumbar region be to the left, and the shape of the spine will more or less resemble the letter S, according to the extent of the contortion. The consecutive curve is the result of an effort to maintain the upright position; or, in other words, when a primary curve is formed in the lumbar region, the muscles on the opposite side of its convexity, and higher up, draw the spine in the contrary direction, and the one curvature compensating in a measure for the other, allows the centre of gravity still to fall upon the pelvis. The primary curve is always the bolder, and the consecutive curve may occupy the dorsal, and a considerable part of the cervical region; or there may be two consecutive curves in opposite directions, one in the dorsal and the other in the cervical region.

The same explanation may be given of the operation of several other exciting causes, such as the bad habit of standing, sitting, or reclining in an awkward attitude, or of leaning to one side to obtain relief from the weariness and aching sensations caused by too long confinement to one position. The disproportioned use of the muscles of one side is well

known to be an exciting cause of curvature. Examples are occasionally met with in blacksmiths, dragoons, and in persons engaged in peculiar avocations, in whom the muscles on one side, from being frequently called into action, become so strong and so fully developed, as to overpower those of the opposite side, and draw the spine out of the perpendicular. Mr. Child records the case of a printer's apprentice, who was in the habit of frequently pulling the press with his right arm, and this gave rise to a curvature in the dorsal region with the convexity to the right side; the rhomboidei and trapezius muscles being tense, rigid, and prominent. In such cases the primary curve will be in the dorsal region, and will soon be followed by a consecutive curve in the reverse direction in the lumbar region. The improper use of the muscles of one shoulder is sometimes a cause of curvature in females. Mr. Stafford remarks, "A girl shall have ill-made clothes; for instance, one of the shoulder-straps will be constantly slipping off the shoulder; she, of course, will endeavour to replace it; by this effort she is obliged to elevate the shoulder, and thus she not only brings into action the muscles of that side, but at the same time inclines the spine to the one that is opposite. The effect of this position must be obvious, for on the one hand she increases the power of the muscles on one side, which assist in pulling the spine out of the perpendicular; and on the other, the centre of gravity is destroyed." The above are the principal exciting causes, which acting separately, or two or more of them in combination, give rise to lateral curvature; but in some instances the spine becomes distorted without any known exciting cause. Sometimes, although rarely, lateral curvature is found to depend on caries: in such a case, whatever excites inflammation about the spine may be an exciting cause of the distortion. I have in my own collection a good example of this condition, in which the primary curve is in the lumbar region, and is caused by caries of lumbar vertebræ. The possibility of this form of distortion depending on caries, suggests the necessity of great caution in forming our diagnosis. In such cases the curve will be more abrupt in its form, and more rapid in its progress than in the other varieties of lateral curvature.

Symptoms.—The spine exhibits unnatural, but seldom abrupt, deviations from the mesial plane. These are accompanied, more or less, with a sense of weakness and weariness, which, in some instances, increases especially towards night, and after exercise so greatly as to become even painful, and to produce a desire to lie down in order to relieve the spine from the superincumbent weight. If the distortion depend on caries (which is exceedingly rare), there may be actual pain; but this state sometimes exists, as has been already stated, without the patient being

Fig. 118.



Fig. 118. From a patient.

sensible of any pain. The local appearances vary according to the extent, direction, situation, and number of the curvatures. If there be two curvatures, the one in the lumbar region, with its convexity to the left side, and the other in the dorsal, with its convexity to the right, there will be a falling-in of the right loin, a fulness in the corresponding part on the left side, and an appearance of projection and elevation of the hip; an alteration, also, in the form of the chest, which will be elongated, prominent, and round on the right side, and shortened and flattened on the left; the right shoulder will be elevated and project outwards, and the right mamma will be prominent; the left shoulder will fall down, and the mamma, from the flattened state of the thorax, appear smaller than on the right side. The rationale of these symptoms will be obvious, when the effects of lateral curvature upon the thorax are explained. Two of the most striking symptoms are the "growing out," as it has been called, of the right shoulder, and the prominent and elevated appearance of the hip. The extent of the above symptoms will correspond with the boldness of the curvature. When the convexity of the lumbar curve is to the right side, and that of the dorsal to the left, the appearances which in the former case were observed on the right will be found on the left side, and *vice versa*. The above are the symptoms of lateral curvature, when there are only two curves, and these situated as described, and not of a very great extent. In an advanced stage, however, of this disease, an alteration is observed in the symptoms; the breast, like the scapula, does not remain prominent on the convex side of the dorsal

Fig. 119.



curvature, but falls backwards, in consequence of the ribs in front losing their convexity and becoming flattened as the disease makes progress. If, however, there be three curvatures, and if a few of the superior dorsal vertebræ be, together with the cervical, involved in the uppermost curve, and if the distortion be considerable, the appearance will be different. Besides the symptoms already mentioned in the lumbar region, and the projection backwards of the scapula on the convexity of the dorsal curvature, there will be flatness of the chest and falling-in of the neck on that side, together with fulness of the neck and breast, and elevation of the shoulder of the opposite side. In this variety the scapula projects backwards at its lower, and falls forwards at its upper part, on the convex side of the dorsal curve; but it is not raised so much upwards as on the opposite side. The appearance is peculiar, from the projection backwards of the shoulder and the falling in of the mamma on the one side, and the rising up of the shoulder, and the prominence of the mamma on the other. The convexity of the uppermost curve produces the fulness on the one side of the neck, and

Fig. 119. From a patient in my wards in the Royal Infirmary.

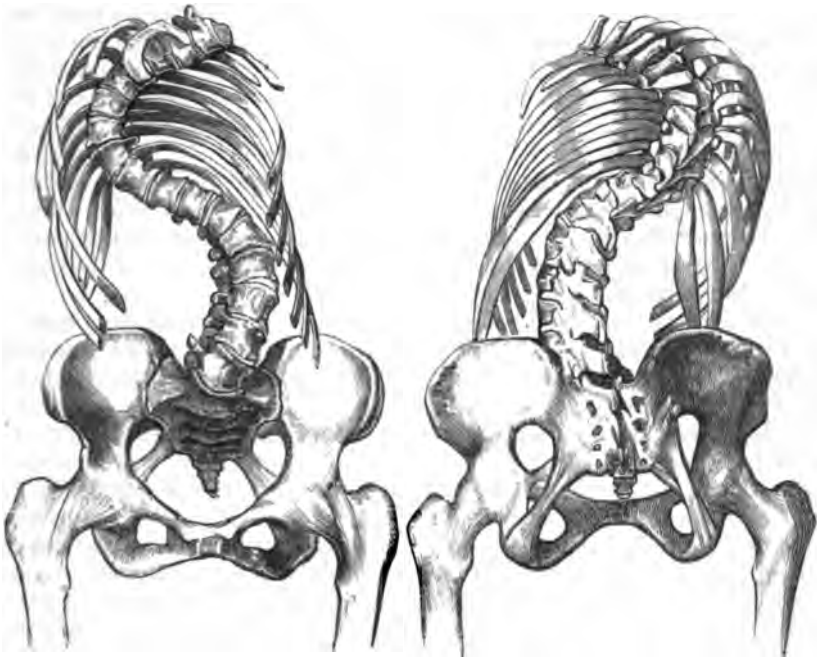
the explanation of the other peculiar symptoms is, that, on the side on which the mamma is prominent and the shoulder raised up, the superior ribs are supported by the convexity of the uppermost curve, whereas those on the opposite side are connected with the concavity, and, therefore, fall in.

EFFECTS OF LATERAL CURVATURE ON THE SPINE AND ON THE TRUNK.

With reference to the vertebral column, it is observed that the effect of the curvature on the convex side is to separate the transverse processes from one another, to incline the spinous processes outwards, and to enlarge the bodies of the vertebræ and the intervertebral substances, so that they have the appearance of being expanded. On the concave side the reverse prevails; the transverse processes are brought too near each other, the spinous processes curve inwards, and the bodies of the vertebræ and the intervertebral cartilages are diminished in depth by interstitial absorption. The height of the column is diminished, and if the distortion be considerable, there is rotation of the spine to the same side as the curvature. The muscles which run along the convex side

Fig. 120.

Fig. 121.



are inordinately stretched, and consequently weakened; while those on the concave side are preternaturally contracted and rigid. These alte-

Fig. 120. Front view of lateral curvature of spine. From a preparation in my museum.

Fig. 121. Back view of same preparation.

rations are not only to be discovered on dissection, but in the living body also. The surgeon can satisfy himself of the existence of these alterations both before and after dissection. If the curve originate in the use of one shoulder more than the other, the muscles extending from its convexity to the scapula will be preternaturally tense and large, when compared with those of the opposite side. There will be, on the concave side of the curve, flattening and shortening of the thorax, with diminution of the intercostal spaces; while on the other side, the thorax will be elongated and rounded in form, and the intercostal spaces enlarged, in consequence of the ribs being removed farther from each other. The condition of the ribs explains the symptoms observable about the shoulders and mammæ. The transverse measurement of the thorax is diminished, and, in consequence, the sternum usually becomes preternaturally prominent: and, in many instances, the diminished capacity and changed form of the cavity of the chest interfere with the easy play of the heart and lungs, and thus occasion to the patient annoying sensations within the chest.

Treatment.—The treatment of this affection, when dependent on rickets or caries, consists in the application of the principles laid down for the treatment of those particular diseases. If the curvatures arise from the operation of other causes, and are neither of great extent nor of long standing, they may, by judicious management, be completely removed: in this case, the treatment may be termed *curative*. But when the deviation of the vertebral column is to a great extent, and the bones have acquired their consolidated state, the unnatural configuration of the bony structure cannot be removed; and all the surgeon can then do is, to employ remedies calculated to prevent the progress of the deformity. Here the treatment may be denominated *palliative*. When the deformity is caused by the disproportioned action of the muscles of one side, their action must be discontinued, and the muscles of the opposite side brought into exercise.

If the curvature has arisen from standing on one leg, or from any of the various improprieties of attitude already referred to, an essential part of the treatment is the discontinuance of the bad habit; for so long as the exciting cause is allowed to remain in operation, no treatment will be of any avail. Another great object will be, to call into use those muscles whose action will tend to bring the spine into its proper position: these will, of course, be the muscles attached to the concavity of the curvature. This may be done in various ways, by the use of the dumb-bell, turning the wheel, or by such gymnastic exercises as tend to bring into play the muscles of the trunk,—those especially whose contractions are calculated to draw the spine to the erect attitude. In the case of children, a simple and excellent plan is, to induce them to play at such games as will call into exercise those muscles by which the vertebral column may be restored to its normal form; thus, if the curvature has arisen from standing on one leg, Mr. Stafford suggests, that a good way of bringing into action the muscles of the opposite side would be the favourite game of hop-scotch; and when it has been caused by the disproportioned use of the muscles of one shoulder, as in cases of raising up the shoulder to obtain relief from the annoyance of the shoul-

der-strap falling down, he advises that the game of battledore and shuttlecock be played with the opposite hand. When the disease has not made great progress, and the bones have not become stiff by ankylosis, or by great interstitial absorption on the concavity, and growth and expansion on the convexity, of the curve, the means above mentioned will generally be found sufficient to restore the spine to its normal form.

When the disease has arisen from general debility, however induced, which has rendered the spine too weak to support the superincumbent weight, the treatment will consist in the use of means calculated to strengthen the general system, and in certain local measures directed to the state of the spine. Some of the most important measures for the purpose of invigorating the system are, the adopting of a generous diet, living in a pure and bracing atmosphere, the use of wine, provided it agree with the patient, the due regulation of the bowels, and the employment of whatever medicinal tonic seems most indicated by the particular situation of the patient. To maintain the right performance of the functions of the digestive organs, and to preserve the bowels in a state neither relaxed nor constipated, are often the only occasions for the employment of medicine internally. Sea-bathing at the proper season is often advantageous; but if this be inconvenient, recourse may be had to salt ablutions, or sponging the body with salt-water. In addition to these, the regular and daily use of friction by means of the hair-glove or flesh-brush, and exercise on foot should be employed, care, however, being taken that the exercise be not to such an extent as to induce weariness. After exercise the patient should rest in a recumbent position until she experience a fitness for further exertion. To keep patients always in that position would be extremely injudicious, as the debility thereby induced would predispose more strongly to the disease; but to recline on a couch or sofa for three or four hours altogether in the course of the day, not at once but at different periods, with intervals of gentle exercise or amusement, would relieve the weak part from the superincumbent weight, and thus be not only agreeable to the feelings of the patient, but also calculated to be useful. Together with this treatment certain local measures are beneficial, such as friction along the spine with some stimulating embrocation, especially along the muscles which chiefly require to be stimulated. Exercising the muscles of the trunk with the body in the horizontal position, if conducted with judgment and care, is also often highly beneficial; the exertion of muscular action, while the spine is free from the pressure of the superincumbent weight, tends to restore it to its normal position. Such exercises, by calling into play the muscles extending between the ribs and the arm, are also particularly well adapted to correct the deformity of the thorax. The apparatus employed by Mr. Shaw, and the couch with the exercising frame recommended by Mr. Tuson (a modification of which, in a greatly simplified form, I have employed for exercising the muscles while the body is in the recumbent position) are well adapted for the purpose; but all that is required can easily be fixed to the extremity of a couch. It is unnecessary to describe the different pieces of apparatus above referred

to, for if the principle is to be adopted of exercising the muscles with the body in the recumbent position, there can be no difficulty in contriving mechanism for its practical application. Such branches of a girl's education as require sedentary attention, much mental exertion, or long confinement to the sitting position, must be suspended. Tight lacing and all mechanical supports, which tend to retard the development, or prevent the exercise of the various organs, or induce the patient to lean to them for support instead of endeavouring to maintain a proper attitude by the action of her own muscles, are positively injurious; but still, if the patient be unequal to the necessary exercise, some support during part of the time she is in the erect attitude, will be found beneficial. Some of the spine-supporters, which sustain the superincumbent weight, or rather transmit it to the pelvis without exerting pressure, are best adapted for this purpose.

Of late years recourse has been had, for the cure of lateral curvature, to the operation of dividing certain muscles of the spine. This is in some respects analogous in principle to the operation of dividing the sterno-mastoid muscle for the cure of some forms of wry-neck, or of dividing certain muscles for the cure of club-foot; although certainly we have no reason to expect it to be so generally useful as those operations. When the distortion proceeds from disease of the bones, or from any constitutional disease, or from general debility, an operation would be most unjustifiable; and I think it will be evident from what has been stated regarding the causes of lateral curvature that the cases must be exceedingly few, in which there is a reasonable prospect of an operation proving advantageous. In cases of curvature arising from or attended by an excessive exertion of certain muscles, the operation has been performed with the view of weakening the muscles to whose overaction the original production, or the subsequent continuance of the curvature, is in part to be attributed. Thus the muscles extending from the convexity of the dorsal curve to the scapula have been divided, when the curvature has been caused by an inordinate action of the muscles of that side. In other instances the muscles along the concavity of the curve have been divided; because when a curvature takes place, the muscles attached to its extremities and situated along its concavity have their extremities brought nearer to each other than is natural, and then contracting and accommodating themselves to their new position, they not only offer an obstacle to the removal of the curvature, but also tend by their contractile power to increase it. Mr. Child records a case of a printer's apprentice who had curvature in the dorsal region caused by pulling the press with his right arm; the rhomboidei and trapezius muscles were tense, rigid, and prominent. Mr. Child divided the muscles attached to the convexity of the curve, by the overaction of which the distortion had been produced; and the result was favourable. Mr. Whitehead of Manchester, has successfully performed the operation of dividing the muscles along the concavity of a curvature. The two cases are described in the "*Medical Gazette*," the former in the number of Nov. 27th, 1840, and the latter in that of December 4th, 1840. The operation of myotomy for the cure of distortion of the spine has been

performed by M. Genrin of Paris, Mr. Skey of London, Dr. Hunter of Glasgow, and others, with different results; but as yet the impression of surgeons regarding it is decidedly unfavourable.

MIXED CURVATURE.

As the various conditions on which curvatures depend, and the principles of treatment suitable to each, have been already explained, it appears unnecessary in reference to mixed curvature to say more than that the important point is, to ascertain the cause of the curvature, and to adapt the treatment accordingly.

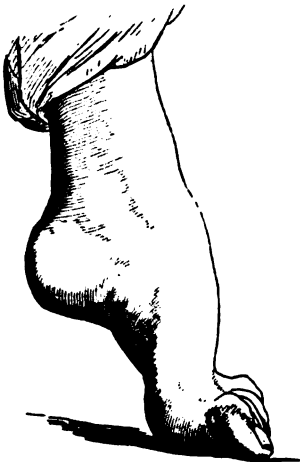
CHAPTER XI.

TALIPES, OR CLUB-FOOT.

OF this there are four varieties, namely, talipes equinus, talipes varus, talipes valgus, and talipes calcaneus.

Symptoms.—Talipes equinus is the most simple, though not the most common, variety of these deformities. It may vary from slight elevation of the heel to that position in which the heel is so drawn up, that the foot is almost in a straight line with the leg. The weight of the body in walking is borne by the anterior part of the foot, and in a pure example, equally by all the metatarsal bones; but in some cases where the toes incline slightly inwards or outwards, approaching somewhat to other forms of talipes, the anterior part of the sole of the foot cannot be applied evenly to the ground, and the weight is received chiefly by the metatarsal bone of the little or of the great toe, according as the tendency to lateral displacement is inwards or outwards. The inward tendency is the more common, owing, it has been supposed, to the circumstance that the natural configuration of the foot admits of more extensive adduction than abduction. In many instances, patients, when

Fig. 122.



they stand carefully upon the affected foot, appear to tread evenly; but in walking, as soon as the foot is placed in the extended position, so that the posterior part of the astragalus, which is narrow from side to side, is received between the two malleoli, the foot inclines inwards, and the ball of the little toe principally sustains the superincumbent weight. There is great lateral mobility of the foot, especially in the extended position. The muscles of the calf are contracted, and the tendo Achillis is prominent, tense, and unelastic. These conditions are rendered still more apparent by any attempt to bend the foot; and the extent to which that can be done, and the amount of resistance offered, vary according to the extent of the distortion. The foot is unusually convex above and concave below, and in cases of considerable standing, the foot is smaller, and the leg, both in length and thickness, less, than on the opposite side, showing that the parts are less developed in every way.

The gait of the patient is peculiar and unpleasing. Pain and a sense of weakness are often experienced at the instep from the strain on the parts in making exertion; and walking is often rendered still more disagreeable to the patient by painful corns forming on the parts on which he treads. In many cases the patient can, by a voluntary effort, slightly diminish the deformity; but when the distortion is caused by paralysis of the flexors of the ankle, he cannot by a voluntary effort bend the foot in any degree; and in such case, if the surgeon place his finger over the belly of the *tibialis anticus*, or of any other muscle in front of the leg, and desire the patient to endeavour to excite it to contract, no motion whatever will be felt under the finger,—the volition is not followed by any change in the muscles, which the patient desires to call into action. This method of examination it is desirable to institute, before a prognosis be given, as the result of treatment is not likely to prove so satisfactory when paralysis is the cause. The above are the symptoms which in a greater or less degree, according to the extent of the distortion, characterize this deformity. *Talipes equinus congenitus* is the name given to it when it exists from the period of birth; and *talipes equinus acquisitus* when it takes place at a subsequent period.

ABNORMAL CHANGES.

The bones which present the greatest deviations from their natural condition are the astragalus, *os scaphoides*, and calcaneum, but chiefly the astragalus. They are generally somewhat diminished in size, especially the astragalus; and its natural articular facets for the bones of the leg are roughened and almost denuded of cartilage, while new ones are formed at a greater or less distance backwards according to the degree of the deformity; in the higher grades these surfaces are furnished partly by the astragalus, and partly by the calcaneum. The head of the astragalus is diminished in size, and its articular surface for the *os scaphoides* is unusually small. The *os scaphoides*, which is also diminished in size but not altered in form, is drawn downwards; and hence the upper part of the head of the astragalus is prominent on the dorsum of the foot, and an unusual extent of the upper aspect of the bone presents itself, in consequence of the bones of the leg being removed so far backwards. The calcaneum is seldom fully developed. In the higher grades of talipes it furnishes a facet for the bones of the leg. The surface by which it articulates with the *os cuboides* is contracted in extent, and the upper and anterior part of the bone is prominent on the dorsum of the foot in consequence of the *os cuboides* being drawn downwards. The remaining bones of the foot present their natural characters, except that they usually show more or less of deficiency in their development, and all the bones of the tarsus and metatarsus are so arranged, as to give the foot an unusual convexity above, and a corresponding unusual concavity below. The toes are extended, but Dr. Little has given a delineation of a curious specimen belonging to the museum of the London Hospital, in which the toes were unusually drawn downwards towards the calcaneum, which, Dr. Little remarks, was owing to the circumstance that the person to whom it had belonged, had not placed the foot upon the ground, but walked upon the knee.

The articulating facets of the tibia and fibula are roughened in front and denuded of cartilage, from not coming into contact at these parts with the astragalus. The above are the abnormal conditions of the bone in talipes equinus. That which invariably exists, and is regarded as the distinguishing peculiarity, is a greater or less displacement of their articulating facets.

The *ligaments* in this and the other varieties of talipes are changed, being relaxed and shortened so as to correspond with the situation of the bones. These alterations are now considered as consequences, not as causes of the deformity. At page 45 of his interesting book on Club-foot and other analogous deformities, Dr. Little remarks, "The ligaments cannot directly influence the production of the deformity; but its progress may be facilitated by their relaxation; the restoration of the foot is impeded by their diminished length, the result of long continuance in an improper position."

The *muscles* are, in all the varieties of talipes, invariably affected with abnormal conditions, which are regarded as the causes of these distortions. The distinguishing peculiarity is, that the balance between antagonistic sets of muscles is interrupted. The disturbance of the equilibrium of the muscles may arise from complete or partial paralysis of the tibialis anticus, or of it and of one or more of the other flexors of the foot, and the consequent contraction and structural shortening of the muscles at the back of the leg; or, it may be occasioned by the spasmodic contraction; and, if of long standing, the consequent structural shortening of the muscles of the calf, without paralysis of the muscles in the front of the leg; or, it may be unattended by either paralysis or spasmodic contraction, and be the result (as is often observed when the whole voluntary power of the limb is diminished), of the organic contraction of the extensors of the foot preponderating over that of the flexors.

The gastrocnemii are the muscles chiefly involved in the production and maintenance of this deformity; and although sometimes other extensor muscles are affected, it is comparatively rare that the division of any of the tendons, except that of the gastrocnemii, is necessary.

These are the principal conditions of the muscles which cause genuine talipes; but deformities which in external characters resemble talipes, may arise from contraction of the gastrocnemii excited by abscess of the leg, or by caries or necrosis of either of the bones of the leg; from cicatrization of extensive ulceration; or, from the maintenance of the foot in a particular position, assumed in consequence of inflammation or other painful affections of the joints. In hysterical females, the signs of talipes are sometimes exhibited, constituting what has been called talipes equinus hystericus; and in many instances these symptoms have been found to subside under the treatment proper for hysteria. In cases where dissections have been made, the blood-vessels and nerves were found to be, like all the other structures, reduced in size; but from what is stated above, it will be evident, that of all the abnormal conditions, that of the muscles most chiefly engage the surgeon's attention, as to that must be referred the existence of the deformity; and to the

removal, therefore, of that condition, the remedial measures are to be directed.

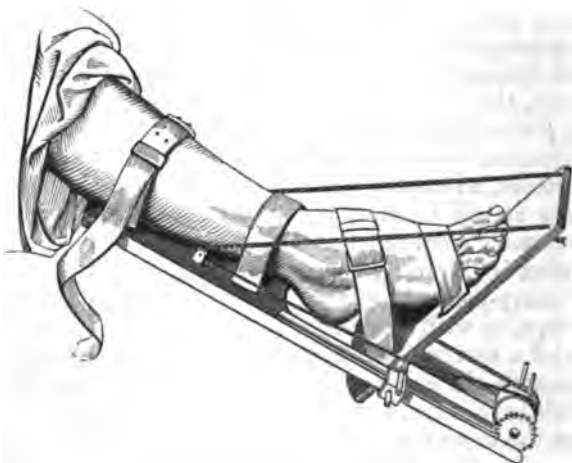
Treatment.—An improved knowledge of the exciting causes of talipes, and of the abnormal conditions of the parts, has led to the adoption of sounder and more rational principles of treatment than formerly prevailed. In all cases of talipes equinus, whether congenital or acquired, whether induced by spasmodic contraction of the muscles at the back of the leg, or by paralysis of some of those in front, if structural shortening has occurred to any considerable extent, the proper treatment consists in the division of the tendons of the shortened muscles, and the restoration of the foot to its proper position by means of mechanical apparatus. The nature of the operation and of the mechanical apparatus will be presently explained. In cases for which it is suitable, nothing more satisfactory can be desired than this method of treatment; by it I treated, with complete success, a case of talipes equinus of thirteen years' duration; and of the many successful cases recorded by Dr. Little in his treatise on this subject, the second had existed for fourteen years, the fourth for twenty-nine, and the fifth for thirty-five years, and yet the results were perfectly satisfactory. When the structural shortening is to a slight extent, the judicious employment of mechanical treatment, without division of tendons, will often prove efficient. In each of the two classes of cases, in that which requires the division of tendons, and in that which will yield to the judicious application of mechanical treatment alone, the origin of the disease should be minutely inquired into; and if the disturbance of the equilibrium of the muscles arise from paralysis of one or more muscles, the state of the central parts of the nervous system must be attended to; or if by the reflex and incident functions of the nervous system, it has originated in disorder of the digestive apparatus, or in derangement of other organs, treatment must be directed to the removal of the cause, unless it has been of so long standing, or of such a nature as to preclude all hope of removal. In many cases, where there is no structural shortening, medical treatment directed to the origin of the disturbance, whether in the nervous system, the digestive apparatus, or in some other organs, will, by removing the origin of the disturbance, cure the deformity. In such cases an operation is not advisable, but it is prudent, together with medical treatment, to employ friction, manipulation, and such mechanical appliances as will be most likely to prevent structural shortening while the spasmodic contraction remains.

The operation is extremely simple, and may be performed with any very narrow sharp-pointed instrument, such as a small, straight, sharp-pointed bistoury, or with an extremely narrow knife in the shape of a scalpel, or with a narrow-bladed instrument, not more than an eighth of an inch in breadth, the cutting edge of which does not extend more than five or six-eighths of an inch from the point, the remaining part being blunt, so that the instrument can be turned in the wound, and thus the operation be effected without so extensive a division of the skin, as would probably be occasioned by an instrument with a cutting-edge of greater length. It is very important that the wound of the integument should be the least possible. In talipes equinus, the tendo Achillis is

usually the only tendon that requires to be divided, but in some instances the section of the tibialis posticus and flexor longus pollicis is also needful. The division of the tendo Achillis may be effected in the following manner:—While the knee is extended and held by one assistant, and the heel depressed and the toes raised as much as the structural shortening will permit by another, for the purpose of rendering the tendon prominent and tense, the surgeon introduces the flat blade of the knife at one side (usually the inner side) of the tendon, and having passed it under the tendon until the point reaches the opposite side, turns the edge backwards, and divides the tendon in withdrawing the knife. The division is attended with a grating noise, and its accomplishment is evidenced by the removal of the resistance to the depression of the heel, and by the hollow that is left under the integument. All experienced orthopædic surgeons prefer the transverse to the oblique section (which some have recommended because a larger surface is thereby formed for the effusion of the uniting medium); and it may be effected, as described above, by carrying the knife before the tendon, and cutting from before backwards, or by pinching up the integument and sending the knife between it and the tendon with the sides of the knife backwards and forwards, and then directing the edge against the tendon, and cutting from behind forwards. By either method, the operation may be performed in a few seconds; not more than a drop or two of blood escapes, and the external wound is extremely small, being not more than the breadth of the instrument, which is carefully withdrawn through the opening, by which it was introduced.

A small piece of plaster is placed over the opening, and the foot is allowed to remain in its deformed position until the wounds be perfectly healed, which is usually not more than two or three days. As regards

Fig. 123.



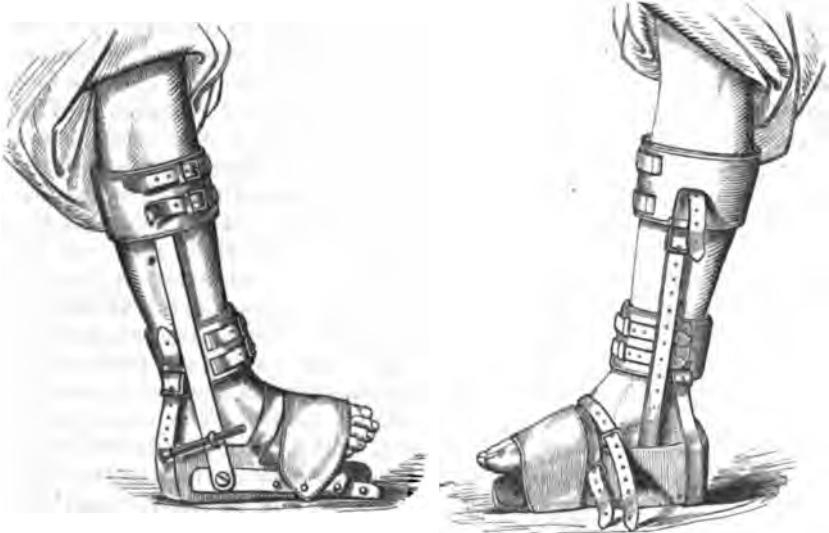
the operation, there is merely a puncture of the skin, and the division of the tendon is subcutaneous, so that neither the tendon nor its sheath

Fig. 123. Stromeier's apparatus applied.

being exposed, the danger of inflammation is greatly diminished ; and that it may be yet further diminished, and the risk of suppuration avoided, no means should be taken to restore the foot to its proper position, until the wound be perfectly cicatrized. Such is the doctrine laid down by Stromeyer, and followed by the most experienced orthopædic surgeons, as to the period at which extension should be commenced. But M. Bouvier and Mr. Whipple recommend that it be commenced immediately after the section of the tendons. There is also a difference of opinion as to the manner in which extension should be employed. Stromeyer, Little following his example, and most others, bring the foot gradually to its proper position ; whereas others endeavour to effect this at once. The directions of Stromeyer, both as to the period for commencing extension and the method of employing it, are those which have met with general approval. The extension having been commenced, should be daily increased, care being taken not to employ it injudiciously, or to apply so great a pressure as to cause abrasion or irritation, which might render continuance of the extension injurious. The extension is necessary for stretching the ligaments, for restoring the bones to their normal position, for elongating the muscles on the back of the leg, and for allowing, by bringing up the toes, the contraction of the muscles on the front of the leg, by which the foot is maintained in its proper position. Together with extension, bathing, fomentation, and friction, should be daily employed, and will be found beneficial.

Fig. 124.

Fig. 125.



Of the many kinds of mechanism contrived for the purpose of accomplishing extension in the various forms of talipes, Stromeyer's stretching board, and Dr. Little's apparatus, are most generally approved. They

Fig. 124. Little's boot applied. One view. Fig. 125. Little's boot applied. Opposite view.

are the only kinds of which, until lately, I have had experience; and they certainly answer most admirably the purposes for which they are intended. The former is the more suitable for talipes equinus, and for some cases of talipes varus; but for others, Dr. Little's apparatus will be found more useful, as fulfilling more indications than the stretching-board of Stromeyer. These pieces of mechanism, and the mode of their operation, may be understood from the accompanying wood-cuts. The apparatus of Dr. Little is a modification, with various improvements, of one originally used by Scarpa. By means of mechanism, the foot is gradually brought into its proper position, and the muscles that are undivided, the ligaments, and the lymph effused between the ends of the divided tendons, are cautiously extended; but the use of the apparatus should be continued after the foot has been brought into its right position, in order to obviate a tendency to contraction, which continues for some time to exist in the effused lymph. When walking is resumed, care should be taken to place the foot properly on the ground. In this variety of talipes, walking, after the proper period, tends to prevent a return of the deformity and to perfect the cure; and it may be ventured upon earlier than in some varieties, which will afterwards be described.

TALIPES VARUS.

Symptoms.—While talipes equinus is the most simple, talipes varus is by far the most common variety of these deformities. "It is that deformity in which the foot," as Dr. Little remarks, "undergoes a threefold alteration of its position in relation to the leg: extension, adduction, and a rotation of the foot, somewhat analogous to supination of the hand, taking place to a greater or less extent, according to the severity of the disease. The heel is drawn upwards (extension), the toe is turned inwards (adduction), and the patient treads on the outer edge of the foot only, the inner edge being raised from the ground (rotation). This threefold alteration from the natural position of the foot, occasions the

Fig. 126.



most serious impediments to steady or comfortable walking; and when the disease reaches the highest gradations, the foot assumes a frightfully distorted appearance." In many instances, the distortion is so great that the sole of the foot is vertical instead of horizontal; and the patient, unable to apply any part of it to the ground, supports the weight on the outer edge of the foot. The patient, when standing, keeps the legs removed from each other to balance the weight of the body; the gait is unpleasing and unsteady, and walking is rendered not only unusually fatiguing, but also very painful by the strain upon the foot, and the swellings which form upon the skin on those parts on which the patients tread. The

foot is preternaturally small, as well as the limb, from the want of proper development, and it deviates from the natural condition not only in its

relation to the limb, but also in its shape; for its dorsum presents an unusual convexity and the sole a corresponding concavity; its inner edge is short and unusually concave; its outer edge is convex, and in many cases has a semicircular outline, on the middle part of which only the patient is able to tread. The patient has no power to bend the foot by voluntary effort; the attempt to do so merely increases the adduction. When the deformity is slight, the foot may be brought into a natural position, but as soon as the force is removed, it returns to its former state. When the deformity is more extensive, the surgeon cannot, by taking hold of the foot, bring it into a proper position, and in the worst cases he can only move it slightly in the right direction. In all circumstances, but especially in attempting to bring the foot to a natural position, the tendo Achillis and inner division of the plantar fascia, and often the tendon of the tibialis anticus, feel tense under the integument. But more particular reference will be made to the structures which are shortened, under the head of the abnormal conditions.

These symptoms may either exist at birth or arise afterwards; in the former case, they constitute talipes varus congenitus, in the latter, talipes varus acquisitus.

Abnormal Conditions.—In talipes varus there are the same abnormal conditions of the bones as in talipes equinus. This might have been expected, as extreme extension is common to both deformities. It is unnecessary again to enumerate these conditions; but there are also other changes in talipes varus, produced by the adduction and rotation. The changes, as in talipes equinus, consist principally of alterations in the relations of articulating facets to each other. According to Scarpa and other anatomists, the astragalus undergoes less alteration of position than either of the other tarsal bones. Although its articulating facets for the ankle joint are displaced by being pressed forward and outward, the portions of these surfaces towards the outer side being further displaced than those towards the inner, still some parts of its surfaces are in contact with some parts of the surfaces for the ankle joint furnished by the bones of the leg; and there is no condition calculated to prevent a cure, if the cause of the deformity be removed. The posterior extremity of the calcaneum is drawn upwards and a little outwards, and its anterior extremity a little inwards; and the scaphoid, cuneiform, and cuboid bones not only present the same peculiarities as in talipes equinus; but they are also, by the adduction and rotation of the foot, twisted inwards and rotated on their own axes; so that their inner edges are in a measure directed upwards, and their outer edges downwards. The os scaphoides has been found so much drawn inwards, as to have its inner extremity articulating with the anterior part of the malleolus internus, and connected with it by a powerful ligament. The os cuboides, instead of articulating with the whole of the anterior part of the calcaneum, is more or less separated from it above, by being drawn downwards and inwards; and sometimes, when the deformity has been very great, they have been found in contact only at the under parts of their articulating facets,—a triangular space, the base of which is upwards, intervening between them. The above are the essential peculiarities of the bones in talipes varus. Pal-

letta, Delpech, Cruveilhier, and others, have found the malleolus internus in some instances deficient in size; and in one case which came under my own observation, it was remarkably small; but this condition does not always appear. The ligaments adapted to the altered relations of the bones, and the stretching of those which are preternaturally short, is one of the causes of uneasiness in the restoration of the foot to its proper position, by the treatment after an operation. The abnormal conditions of the muscles and tendons are considerable and important, since it is by them that the deformity is produced and maintained. Some muscles are shorter, others longer than natural, and their equilibrium is disturbed. This disturbance may be produced in either of the ways mentioned in the description of the abnormal changes in talipes equinus. The number of muscles which are contracted varies in different degrees of the deformity. In many cases, especially when the deformity is slight, the gastrocnemii alone are so much contracted as to require division of their common tendon; but in other instances, the tendons of the tibialis posticus, flexor longus pollicis, and tibialis anticus, require division. The tibialis anticus, although naturally a flexor of the ankle joint, has sometimes, in aggravated cases, its tendons so far deflected inwards as to increase the deformity and require division; and in a case in which I lately operated, where the deformity had attained its highest grade, the extensor longus pollicis was so far deflected inwards, and so tense, that it was necessary to divide it as well as the tibialis anticus, the tendons of the gastrocnemii, the flexor longus pollicis, and the tibialis posticus muscles. When the muscles are spasmodically contracted, their bellies feel firm and hard to the touch, like muscles affected with spasm; but when the deformity is attended with structural shortening, the muscular tissue is in a state of atrophy, both its length and thickness being diminished; and sometimes (though such an occurrence is now believed to be very rare), it is converted into a fatty substance, constituting what is termed the fatty degeneration. There is often shortening of the plantar fascia to such an extent as to require the division of its inner portion. This shortening, however, is not, as Maisonnabe believed, a cause of the deformity, although it often presents such an obstacle to the restoration of the foot to its proper position as to render division necessary. The appearance of the limb slightly resembles its appearance in a state of atrophy. Its temperature is often observed to be lower than natural, and on dissection the vessels and nerves, like the other structures, have been found unusually small. Of all the abnormal conditions, however, that of the muscles and tendons especially requires attention.

Treatment.—In determining the most prudent method for restoring the foot to its natural position, the surgeon will be guided by the same considerations as in a case of talipes equinus; and, as the principles of treatment were fully stated under that head, it appears unnecessary to do more than to give some short particulars as to the treatment of those cases of talipes varus in which there is so much shortening of tendons, that their division is requisite, in addition to mechanical treatment, for the restoration of the foot, and also to state the most prudent method of procedure with congenital cases in infants until the period arrives at which an operation may be proper.

With regard to cases which require an operation and mechanical extension for the removal of the deformity, the first point is to ascertain which tendons ought to be divided; and this can only be done by a minute investigation of the case. As was stated in describing the abnormal conditions, in some instances, section of the tendo Achillis is sufficient, and in such cases, the operation is precisely the same as for talipes equinus. In some of these cases, the difficulty of bringing the foot to its natural position is removed on the division of the tendon; in others, a certain amount of resistance is offered by the muscles on the back of the leg, but not more than can be removed by mechanical extension. There are many cases, however, in which other tendons, besides the tendo Achillis, must be divided; most commonly the tendon of the flexor longus pollicis, or of the tibialis posticus, or one or both of these tendons belonging to muscles on the back of the leg, together with the

Fig. 127.



Fig. 128.



tendon of the tibialis anticus in front. In a very interesting and satisfactory case, which I treated lately, and from which the accompanying figures were taken, it was necessary to divide all the above-mentioned tendons, namely, three on the back of the leg, and two on the front, that of the tibialis anticus, and that of the extensor proprius pollicis. The two last-mentioned tendons were so deflected inwards and shortened, as to maintain the deformity. Occasionally it is also necessary to divide the plantar fascia before the deformity can be entirely removed. In Dr. Little's interesting treatise, various cases of talipes varus are recorded, in which a cure was effected by section of the tendo Achillis, followed by mechanical extension, and other cases, in which division of other tendons also was necessary. In the eighth case recorded in his treatise, the deformity was cured by division of the tendo Achillis, and tendon of the tibialis posticus; in the fourteenth case, by division of the tendo Achillis and the tendon of the flexor longus pollicis muscle; in the eighteenth, it was cured in one foot by division of the tendo Achillis,

Fig. 127. Appearance before operation.

Fig. 128. Appearance a fortnight after operation.

and in the other, by division of the tendo Achillis and tendons of the anterior and posterior tibial muscles; and in the twenty-third case, by the division of the same three tendons. More extensive use of the knife than is absolutely necessary is exceedingly reprehensible. The division of the tendons should be subcutaneous, and effected in the same manner as that of the tendo Achillis, and with the least possible injury of the

Fig. 129.



common integument, and the surrounding parts. The tendo Achillis may be divided about an inch above the calcaneum, or a little higher or lower, as the circumstances of the case may indicate; and the most common and advisable situations for dividing the other tendons are, for the tendons of the tibialis anticus and extensor proprius pollicis muscles, the dorsum of the foot in front of the ankle joint, where they appear most prominent; for the tendon of the tibialis posticus, about an inch above the under part of the malleolus internus; and for the tendon of the flexor lon-

gus pollicis in the sole of the foot, where it is found most tense. The foot should be allowed to remain in its unnatural position, until the small wounds are perfectly cicatrized, when extension should be

Fig. 130.



Fig. 131.



commenced, and gradually and cautiously increased, and constantly maintained, until the foot be brought to its proper position. Stro-

Fig. 129. Appearance six weeks after.

Figs. 130 and 131. Talipes varus before and after operation. Treated by Aveling's talivert.

meyer's stretching-board, with a little additional apparatus for more efficiently preventing inversion, will be found a very convenient appliance for satisfactorily fulfilling all the necessary conditions. In slighter cases, or after the foot has been brought nearly to its proper position, or when the resistance to be overcome is not very great, Little's apparatus will be found to answer all the purposes aimed at by mechanical extension. From the tendency of the foot to turn inwards, patients cannot be allowed to resume walking so soon after the operation as they may after the operation for the cure of talipes equinus, and when they venture to do so, the parts should be for some time supported by a boot with a steel spring or stem on the inner side, and the patient should very carefully endeavour to place his foot evenly upon the ground, as from the laxity of the structures which should keep the foot outwards, there is a tendency in the upper part of the tarsus to turn outwards, and in the toes to turn inwards.

As talipes varus is frequently met with in infants, it is important to comprehend distinctly the treatment proper for the deformity at that period. As it is very desirable to avoid the performance of even the slightest operation in an infant, it is fortunate that more cases are curable without operation in infancy than at a later period of life; and, as the difficulties in carrying out treatment by mechanical extension are on many accounts greater, it is a happy circumstance that the resistance is less in infants than in older patients. Whether a case of talipes varus in an infant can be cured by mechanical means, can be determined with certainty only by a trial; but an opinion may be formed by observing the amount of resistance offered to the endeavours to place the foot in its proper position. The treatment recommended by Dr. Little, when the infant is under six months, is to apply tin splints to the inner side of the foot, protecting the limb from pressure by the introduction of cotton wadding, and then to bandage the leg and foot to the splint. The effect of the bandage will be to press the inner part of the great toe, and the upper and inner part of the leg, against the splint, and to diminish the convexity outwards formed by the intermediate parts of the limb. The object aimed at in the first instance is to overcome the inclination inwards of the toes, or in other words, to convert the talipes varus into talipes equinus; and this having been accomplished, a tin splint with the foot-piece bent more upwards should be used for the purpose of bringing down the heel. If the child be more than six months of age, he recommends the employment of his own apparatus, a representation of which has been already given, for overcoming the inclination of the toes inwards, and bringing down the heel. It often happens that, while it is possible to overcome the distortion inwards, the heel still remains elevated, and in such cases, when the child is about to walk, the cure may be very quickly completed by section of the tendo Achillis.

TALIPES VALGUS.

This is much less common than either of the two former varieties of these deformities.

Symptoms.—Here, also, the foot undergoes a threefold alteration of

Fig. 182.



its position in relation to the leg, but the alterations are the very reverse of those in talipes varus. The foot is flexed, abducted, and rotated outwards. Walking is very fatiguing, and in the worst cases, the patient can place no part of the sole of the foot on the ground, but treads upon the inner ankle; the knee of the affected side inclines inwards, and the limb presents the same appearance of atrophy as in the deformities already described. This variety also may be either congenital, or acquired.

Abnormal Conditions.—I have not had any opportunity of ascertaining by dissection the abnormal

conditions. On this subject, Dr. Little says, "I have been afforded only three opportunities of investigating the morbid anatomy of talipes valgus; these were furnished by Professor Müller, and Dr. Pockels of Brunswick. The subjects from which the preparations were taken were full-grown fetuses. In these, so far as the incomplete development of the osseous structures enabled me to judge, the astragalus was twisted in such a manner that the articular facet, which ought to be applied against the inside of the internal malleolus, did not enter the composition of the ankle-joint, but was turned downwards; the navicular bone and calcaneum followed the astragalus, and together with the internal malleolus, would have touched the ground with their internal surfaces, if the feet had belonged to subjects who could have walked. The external edge of the os cuboides, and fifth metatarsal bone, and external surface of the calcaneum, presented directly upwards; the latter, therefore, was in contact with the external malleolus, the prominence of which could not be felt through the skin of the foot."

Treatment.—The treatment must be conducted on the same principles as in the two former varieties. If it be thought that mechanical treatment alone will be sufficient, a convenient appliance for that purpose is Dr. Little's apparatus with the springs on the inner instead of the outer side; and if division of tendons be also required, the same mechanism answers all the purposes of a retentive apparatus. In some slight instances, division of the tendo Achillis alone has proved sufficient; in others, that of the tendons of the peronei muscles has been requisite; and in others, it has been necessary to divide all the tendons of the peronei and gastrocnemii muscles. A convenient situation for division of the tendons of the peronei muscles is five or six lines above the under part of the malleolus externus. On account of the extreme relaxation of the ligaments on the inner side of the foot, it is long before the patient can be allowed to walk after the operation.

TALIPES CALCANEUS.

This appellation was given by Dr. Little to a deformity which he met with in a child four and a half years of age, in whom the fore part of the foot was elevated to the greatest possible extent, and the heel so much depressed as to have the long axis of the calcaneum in a line with the leg, and its posterior surface only touching the ground. The tendons on the front of the leg were tense, and those on the back relaxed; so much so, indeed, that the tendo Achillis could scarcely be felt. The foot was easily brought into its proper position, which proved that there was no structural shortening; and the treatment, which was successful, consisted in the use of a boot for maintaining the foot in its proper position. Dr. Little states, that in a French periodical, a deformity, believed to be of the same kind, is said to have been successfully treated by dividing the tendons of the tibialis anticus muscle. This is the distortion called by some writers hook-foot; the same principles of treatment are applicable as in the other forms of talipes.

Fig. 133.



Having mentioned the symptoms, abnormal conditions, and treatment of these deformities, it may be satisfactory to state very shortly the views now entertained regarding their origin, and the history of treatment now so generally and successfully adopted. The opinions that talipes is caused by an unnatural form of the tarsal bones, or by an alteration of their relative position and connexions, or by an unnatural contraction of some ligaments and elongation of others, or that it is occasioned by undue pressure on the foetal limbs by the uterus, in consequence of deficiency of the liquor amnii, or by external pressure to conceal pregnancy, or by the limbs being arranged in an improper position during foetal life, belong only to the past history of surgery. The opinion now generally entertained is, that these affections are caused by a disturbance in the equilibrium of antagonizing sets of muscles. The writings of Duvernay, Töng, Boyer, Rudolphi, Shaw, Delpech, Stromeyer, Guerin, Duval, and some others, have been the means of gradually leading to the adoption of this view, to its fuller development, and more lately to its perfect confirmation, together with its practical application in the treatment of these affections. Rudolphi appears to have held this view more clearly than his predecessors; he contended that congenital talipes proceeds from the disordered

Fig. 133. From Dr. Little.

influence of nerves on muscles during the period of foetal existence. Delpech at one time believed that talipes originated in malformation of the tarsal bones ; but even then he considered that the muscles contributed to increase the deformity ; but he stated in his treatise "*L'Orthomorphie*," published in 1829, that he had renounced his opinion as to the origin of the deformity, and that he believed its immediate cause to be a disturbance of the natural and necessary equilibrium of the muscles, which disturbance may have resulted from remote influences, as effusion upon the brain or spinal cord, or from hydrocephalus, or from irritation excited in some part of the nervous system, or from direct injury of the nerves leading to muscles ; as, for example, in a case in which the external popliteal nerve was injured, and the injury was followed by paralysis of the tibialis anticus, extensor proprius pollicis, extensor longus digitorum, and peronei muscles, and by contraction of their antagonists, and consequent distortion of the foot ; or in a case in which talipes varus, in an extreme degree, followed injury of the nerves, induced by necrosis and abscess of the femur. Delpech, however, was of opinion that the gastrocnemii are the only muscles involved in the production of talipes varus, and that the adduction of the foot is caused by pressure in walking. Stromeier believes the contraction of the gastrocnemii to be the essential cause of talipes equinus and talipes varus, and the deficiency of the internal malleolus the cause of the inclination inwards in talipes varus. He supposes that if the contraction of the gastrocnemii occur during the early months of foetal life, talipes varus will be the result ; whereas, if it take place at a later period, after the malleolus internus is in a measure developed, the deformity will be talipes equinus, with or without slight inclination of the foot ; in short, he regards contraction of the gastrocnemii as the essential cause, and all varieties as secondary phenomena ; whereas the opinion now generally entertained is that which the observations of Guerin, Duval, and Little, have established, namely, that the deformity, when superadded to retraction of the heel, is to be referred to the action of other muscles affected similarly with those which occasion the retraction of the heel. Dr. Little has given such a clear exposition of his views in the following sentences, that I cannot forbear transcribing them.

"Let us now fully consider those congenital contractions of the feet which depend on derangement of the nervous and muscular systems, and ascertain in what way a permanent deformity arises. In the first place, we will take a case originating from paralysis of the anterior tibial muscle. Here the remote injury, the cause of paralysis, is the same as that of paralysis of other parts of the body, namely, inflammation and the effusion of blood, or sero-sanguineous or serous fluid, in some part of the brain or spinal cord, which compresses or otherwise injures the delicate texture of that part of the nervous centre, whence the affected muscles derive their nerves. The *posterior* muscles of the leg (those of the calf in particular) having lost their natural antagonists, become firmly and permanently contracted, by the constant action of their involuntary contractile power, by which the heel is raised from the ground, Talipes equinus. At an early period of the disease, this contraction may be overcome by forcibly bending the foot with the

hand ; but this, after a time, becomes impossible. The other case, that of a Talipes originating from spasm, admits of a different explanation. The remote cause resides either in the central organs of the nervous system (most probably in the spinal marrow), or it is a disease existing in some other organ of the body, affecting peripheral parts of the nervous system ; for instance, in some one of the viscera of the chest or abdomen, more probably of the latter. From this an injury is propagated to the central organ, and is reflected to certain muscles of the leg, which become spasmodically contracted. In other words, there may be either some deviation from the healthy state in a part of the spinal marrow, where the roots of the motor nerves distributed to the muscles of the calf are implicated or irritated, causing them to become involuntarily contracted ; or there may exist elsewhere some disease, such as irritation of the mucous membrane of the alimentary canal by improper or undigested food, or worms, through which filaments of nerves (named by Dr. Hall *incident*) are excited. These communicate in the spinal cord with other filaments—the *reflex*, or involuntary motor nerves, whereby the muscles of the calf are excited to spasmodic action. In this explanation of the production of non-congenital Talipes I have confined myself to the most simple and intelligible form of Talipes equinus. The Talipes varus differs only in depending on paralysis or spasm of a larger number of muscles. When paralysis is the cause, the peronei muscles have lost their power, as well as the anterior tibial, and long extensor muscles of the toes. If spasmodic contractions be the cause, the posterior tibial muscle, long flexor muscle of the great toe, those of the sole of the foot, and sometimes the tibialis anticus muscle, are partially involved in the production of the deformity. I have here defined the manner in which I consider Talipes to arise after birth. Any cause, whether paralysis or spasmodic, by which the equilibrium, between different sets of muscles that are naturally antagonists, is disturbed, produces the distortion vulgarly called club-foot. Other causes, namely, those which produce a shortening of the muscles and other soft parts upon one side of the leg by disturbing (although in a different manner) the antagonism of the muscles, are capable of producing deformities similar to those belonging to the genus Talipes.

“Having thus offered my opinion of the causes of those deformities of the feet, which take place after birth, and stated the identity of their symptoms, and morbid anatomy with those of the club-foot with which children are born, the probability will, I think, appear obvious that the remote causes are the same ; but there are other phenomena connected with the history of these affections, which render the accuracy of these opinions almost capable of demonstration. Fœtuses which have suffered some evident derangement in the development of the nervous system, such as those denominated hemicephalous and acephalous, or affected with spina bifida, and those born before the expiration of the natural period of utero-gestation, are particularly obnoxious to this deformity of the feet. The occurrence of the perfectly analogous deformity of the hands, which takes place prior to birth, denominated club-hand, in which the flexors and pronators (analogous to the so-called extensors and adductors of the foot), are likewise contracted, corroborates the

opinion that congenital club-foot depends on spasmodic muscular contraction. In the instances which I have examined of congenital deformity of the hand (club-hand), both in museums and in the living subject, the feet were also affected with Talipes, proving the operation of a common cause. Other circumstances corroborative of this opinion are the co-existence with congenital club-foot of congenital squinting, and even congenital stammering or mis-enunciation, diseases which evidently depend either on increase of the involuntary, or the decrease of the voluntary motor powers of the orbital and laryngial muscles. The importance of these facts is increased by the observation I have made, that non-congenital club-foot is likewise occasionally accompanied with strabismus."

The instances are extremely rare in which congenital Talipes is caused by paralysis.

From the time of Hippocrates until March, 1784, the treatment of Talipes consisted in the employment of mechanical pressure, and the varieties were merely different contrivances and appliances for facilitating the adoption of the same principles of treatment; but in 1784, the first step was taken towards the present method, a physician of the name of Thilenius having suggested the division of the tendons affected with shortening; and his suggestion was carried into practice by Lorenz, a surgeon at Frankfort, in the case of a young lady affected from infancy with Talipes varus. The heel descended two inches after the operation, and the lady was able to walk on the entire sole. It was the tendo Achillis that was divided, and the operation was performed under the direction of Thilenius. The division, however, was effected by a large wound. The suggestion of Thilenius was also carried into practice at a subsequent period by Sartorius, whose method of operating, however, was liable to many objections, particularly because he made extensive incisions of the superimposed parts, exposed the tendon at the part to be divided, and after section of the tendon, immediately attempted to bring the foot to its proper position. The consequences were unfavourable, and such as do not follow the operation of section of the tendons as it is practised at the present day. Michälis suggested a different method of treatment, which consisted in a partial division of the shortened tendon, and bringing the foot to its proper position immediately after the operation; he recommended section of the tendon to the extent of one-third of its thickness, by which means its strength would be materially diminished. He performed his first operation in November, 1809. Both Sartorius and Michälis recommended immediate restoration of the foot to its proper position, the one after complete, the other after partial division of the tendon; but neither of their methods of treatment met with general adoption or approval.

Delpech had the merit of conceiving and recommending some new and important principles of treatment. Having observed that after rupture of the tendo Achillis and some other injuries, the uniting medium admits of considerable elongation, it occurred to him that the same elongation could be obtained after section of the tendo Achillis for the cure of Talipes, provided mechanical extension be employed before the uniting medium has acquired great strength and firmness.

He recommended that the section of the tendon should be effected without division of the common integument over it: and in the instance in which he performed the operation, he made a wound of the common integument an inch in length on each side of the tendo Achillis by passing a scalpel between it and the deeper-seated structures; and then by a convex edged bistoury, he divided the tendon from before backwards. He recommended that after the operation, the cut portions should be preserved in apposition, by maintaining the foot in the distorted position by mechanism, until reunion of the divided tendon be effected—that careful and gradual extension of the uniting medium should then be made, until the tendon be of sufficient length; and this having been obtained, that the limb be kept in a proper position by means of apparatus until the new substance has acquired sufficient strength. Delpech performed his operation in May, 1816, and although a cure was effected after a long period, and the patient ultimately recovered, yet there were so many discouraging circumstances, that he never repeated his operation. Although the mode of dividing the tendon recommended by Delpech is exceedingly objectionable, he certainly has the merit of having suggested some important principles in the after treatment. To Stromeyer, who performed his first operation in February, 1881, the praise belongs of having perceived what was objectional, and appreciated what was valuable, in the views of those who preceded him, and of proposing and performing the safe and successful operation, and the mode of after treatment, which are now so generally approved of, and so successfully adopted.

Before concluding this chapter, I may mention that my friend and former pupil, Dr. Aveling, has contrived an admirable apparatus which he calls a talivert, and which I have repeatedly used in private and in public practice. It appears to me exceedingly well adapted for the purposes for which it is intended, and very superior to all kinds of apparatus hitherto employed for the treatment of these deformities. I hope that Dr. Aveling, who is now practising in Kent, will make this useful addition to surgical mechanism known to the profession.

CHAPTER XII.

DISEASES OF THE ARTERIES.

ARTERITIS.

ARTERITIS may be in activity, acute or chronic: and in extent general, invading a large portion of the arterial system, or partial, confined to the trunks and branches of a particular part.

Symptoms and Morbid Appearances.—The symptoms vary according to the intensity of the attack, the stage of the disease, and the changes occasioned by the inflammation in the affected vessels. The diagnosis is often, especially at an early period, extremely difficult: for as the disease in some forms presents no signs peculiar to itself, it is not easily distinguished from common inflammation. While the disease is still slight, and no such changes have occurred in the coats or contents of the vessels as to obstruct their canals, the principal symptom is pain along the track of the vessels, which pain is increased by pressure, motion, or extension of the affected part. On laying the finger over the course of the vessel, the pulsation is felt to be weak, and to convey a tremulous sensation. When the Arteritis is more severe, and invades a part of the arterial system, as for example, when it is seated in the arteries of a limb, and the inflammation is so intense as to give rise to changes which will presently be described, the pain and tenderness are much increased; an incompressible hardness is felt in the situation of the principal arterial trunks affected; and the pulsation, at first presenting the peculiarity above-mentioned, by and by ceases entirely. Together with these symptoms in the tracks of the main trunks, there will, also, be pain in the limb, accompanied with a purplish red appearance, and cedematous swelling: and if the collateral branches be affected the part will exhibit the usual symptoms of gangrene. If the arteritis be but to a slight extent, there may be little or no constitutional disturbance; but when it is intense, so as materially to impede the functions of the trunks and collateral vessels, there will, in addition to the local symptoms, be those of irritative fever.

Some years ago I met with a striking example of acute idiopathic Arteritis in a female, about thirty years of age, who had previously enjoyed uninterrupted good health, except that some years before, she had suffered from an attack of acute rheumatism; but from this she had recovered, and had been for years perfectly well. I was called to see her in consequence of severe pain in the forearm and lower part of the arm, which commenced very suddenly about three hours before I saw

her. At first the pain was chiefly along the course of the radial and ulnar arteries, the pulsation of which vessels at the time I saw her was feeble, and that of the humeral artery was labouring. The pain soon became diffused over the under part of the arm, the forearm, and hand, and was of a bursting character, with oedematous swelling, and a purplish discoloration of all parts below the commencement of the lower fifth of the arm. In the course of eight hours from the beginning of the attack, the pulsation of the radial and ulnar arteries, and of the humeral artery in the two lower thirds of the arm, entirely ceased, and the parts exhibited the ordinary appearance of what is now usually denominated spontaneous gangrene,—the line of demarcation presenting itself at the commencement of the lower fifth of the arm. After some days, it was deemed advisable, by an experienced surgeon and myself, to perform amputation about the middle of the arm. This was done, and the patient recovered, and continued perfectly well for two years, when she left Aberdeen with the intention of residing with her relations in a distant part of the country. The day after her journey she was seized with symptoms in both her lower extremities, similar to those which she had previously had in her arm, and in the course of twenty-four hours nearly the whole of both lower extremities presented the characters of gangrene, and the patient died some hours afterwards. This case furnishes a striking example of the serious consequences which sometimes result from Arteritis; and in the latter part of its history, a remarkable instance of the truth of the observation made by M. Bizot, as to the symmetrical occurrence of arterial disease. Dupuytren was the first who ascribed spontaneous gangrene to Arteritis. The same view was supported by Cruveilhier, who from observations on the human body, and from numerous experiments in which he excited Arteritis in the lower animals, by injecting irritating fluids into the arteries of their extremities, came to the conclusion that the essential character of inflammation of an artery is coagulation of the blood within it, and that gangrene is the result of occlusion, not only of the trunks, but also of the collateral branches. The writer of an able article on Arteritis in the "Cyclopædia of Practical Surgery," speaking of the gangrene produced by Arteritis under the expression "particular form of gangrene," states his opinion, that it is by no means identical with the affection known in this country as Pott's Mortification of the Toes and Feet. I have seen examples of Pott's Mortification corresponding most minutely with the description of the disease in the third volume of "Pott's Surgical Works;" but the distinctive characters of that affection are quite different from those of spontaneous gangrene produced by Arteritis; the latter affection being much quicker in its progress, and, as far as my own experience has given me the opportunity of judging, far more painful and dangerous. It is stated, however, by the writer of the article in the "Cyclopædia of Practical Surgery," that the gangrene from arteritis is less painful than the mortification described by Pott. In the case already referred to, I found, on a careful dissection of the arteries, that their coats presented a red inflamed appearance, as though some irritating fluid had been injected into them; they seemed to be softer and thicker than natural; the

canals, which seemed large, were filled with coagulated blood, and at many points there was a slight lamella of lymph on the internal membrane. No adhesions were perceptible between the coagulum and lymph; but in some examples of this form of Arteritis adhesions are said to have been observed. That the coagulum was formed at an early period is certain, from the cessation of the pulsation.

Such were the symptoms and morbid appearances in a well-marked example of what may be termed acute idiopathic fibrinous arteritis.

Treatment.—This form of arteritis should be treated on the same general principles as inflammation of other parts, namely, by general and local depletion, purgatives, antimonials, diaphoretics, low diet, and the occasional use of opiates for relieving the violent pain. Perfect tranquillity of body and mind should be strictly enjoined, as any exertion or emotion which would accelerate the circulation, would, by increasing the distension of the vessels, aggravate the disease. The prompt but judicious exhibition of mercury, unless an irritable, shattered, or scrofulous constitution should forbid its employment, is calculated to be highly beneficial by checking inflammation and diminishing fibrinous effusion. In the way of local remedies at an early stage, perfect rest of the affected part, depletion by leeches, attention to attitude, and the use of warm and emollient applications are very important.

ACUTE SUPPURATIVE ARTERITIS.

In individuals of shattered, or weak, or cachectic constitutions, a very dangerous form of acute arteritis sometimes, though very rarely, takes place, and gives rise to phenomena, which in many respects resemble those consequent on diffuse suppurative phlebitis. It is much more rare than the latter affection, in consequence of the structures which enter into the formation of an artery being less susceptible of inflammation in any of its forms than those which form the coats of veins. The inflammation has a tendency to spread from the part first affected. It is extremely acute, and is believed to cause the formation of purulent matter at an early period. This by being mixed with the blood in its circulation, is thought to give rise to the peculiarity of the constitutional symptoms, which often prove speedily fatal before gangrene has taken place. Violent irritative fever attends the very commencement of this disease; and it very speedily assumes the worst form of atonic or typhoid fever. Some of the most remarkable features attending its progress are, extreme prostration of the vital powers; a weak, quick, and small pulse; a pallid and shrunk countenance, expressive of suffering; a dull, lurid, dirty-looking hue of the surface of the body; a morbid state of all the secretions; flaccidity of the soft solids; a dry and encrusted tongue; low delirium; and other symptoms indicative of extreme depression of the vital powers. As there is no fibrinous effusion, and in the extremely depressed state of the vital powers, little or no tendency to coagulation of the blood, there is direct purulent admixture with the blood, in consequence of the circulation through the inflamed part not being interrupted. The principal peculiarities of this form of arteritis are, its tendency to become diffuse, to go on to suppuration, and if the patient survive any length of time, to terminate in gangrene as its most usual

local result, and the very early change of the acute irritative fever to one of the typhoid type. The lesions occasioned by acute suppurative arteritis consist chiefly of a dark red, or purple-coloured injection of the walls of the vessel, seen on examining its interior, softening of its more internal textures, and sanious infiltration into them in various situations.

Treatment.—The same local treatment should be adopted as in the variety of arteritis formerly described, together with general antiphlogistic treatment at the very commencement; but in prescribing remedies of this character it is necessary, even from the very first, carefully to keep in view the peculiarity of constitution possessed by most of those who are attacked by this disease, as well as the danger arising from exhaustion at a more advanced stage. However needful it may be at first to use means which produce a relaxing effect upon the capillary vessels, promote secretion, soothe nervous irritation, equalize the circulation, and facilitate the excretory actions, still when the accompanying fever assumes the typhoid type, those adapted to the state of depression and exhaustion, and calculated to support the vital powers, should be actively administered, however little hope there may be of averting an unfavourable result.

ARTERITIS LIMITED TO A PART OF A VESSEL.

This form of arteritis almost always arises from causes which are external and local in their operation, as a wound, or the application of a ligature; and it assumes the sthenic character, and usually gives rise to changes which result from that form of inflammation.

The local results are various, being regulated to a considerable extent by the manner in which the injury is inflicted, and the amount of inflammatory action induced. On this subject, Professor Miller says, "The minor grades will give exudation of a plastic kind, such as we desiderate after deligation; the coats become turgid and coherent; and the canal is completely obliterated at the part affected. A higher grade of action, reaching the truly inflammatory, gives suppuration, usually conjoined with ulceration; a result which we do not desiderate, but on the contrary take every means to avoid, in operations on the larger vessels; hemorrhage being almost certain to follow. A still higher action, more especially if combined with circumstances tending to impair vital power of the tissue, causes gangrene of the vessel, a still more disastrous event; exemplified by the deligation of an artery whose coats have been too rudely manipulated, and too extensively separated from their cellular connexions."

Much insight into the nature and results of adhesive inflammation, by which arteries are obliterated, has been obtained by observing the results of that process on the coats and contents of an artery at different periods after the application of a ligature. Two of the most attentive observers of that process were Jones, who investigated it through its different stages, and Stilling, who mentions seventy experiments on animals,—experiments which were judiciously conceived and carefully performed, and by their results as well as by those of Jones's investigations, many important facts have been ascertained and elucidated. Ac-

cording to Stilling, of whose researches those of others, so far as they go, are confirmative, some of the most important changes after the deligation of an artery are the following. On tying an artery tightly with a small ligature, its two inner coats are cut through, and the canal of the artery is closed by the apposition of the opposite sides of the outer coat, and immediately after deligation, stagnation ensues to the next collateral branches, with accumulation of blood-globules near the ligature, followed by coagulation of fibrin from the fluid constituents of the blood. The coagulum is, during the first eighteen hours, of the form of a cone, with its apex towards the heart, attached only by its base to the part where the ligature is applied; of very slight cohesion, and not of uniform colour throughout, being red towards its base, and of a yellowish colour like that of inflammatory crust towards its apex. It next undergoes a change of form, of firmness, and of colour; its form becomes more spindle-shaped, the end nearest to the ligature tapering less than the other; its firmness increases partly in consequence of stronger coagulation, and partly from effusion from the parietes of the artery; and its colour becomes an almost uniform pink or red. It by and by becomes attached to the parietes of the artery, the attachment being produced by exudation from the vessel, and the adhesions present a filamentous appearance when the plug is detached from the interior of the artery. Stilling, and Dr. Hassie, Professor of Pathology and Clinical Medicine in the University of Zurich, both state that when there has been much exudation, the plug exhibits externally several concentric layers. The outer coat being deprived of its nutrition ultimately gives way. Exudation of lymph takes place into the cellular tissue surrounding the artery—its different coats can no longer be distinguished, and sooner or later, the thin exudation of lymph exterior to the portion of coagulum formed by the coagulation of the blood, the walls of the artery, and the surrounding cellular tissue become condensed into one mass, in which the original parts can no longer be distinguished. Plastic exudation takes place from the extremities of the middle and inner coat divided at the line of deligation, and the ligature, after severing the outer coat, comes away. The condensed mass formed of the exudation from the coats of the artery on the exterior of the coagulum, the walls of the artery, and the infiltrated cellular tissue, are proved by injection to be highly vascular; and that the vessels extend into the coagulum, is demonstrated by the vivid colour communicated to the latter in successful injections,—the appearance being such as, in the opinion of Stilling, to leave no doubt whatever of its being produced by vessels, and not by extravasation. The coagulum at this stage is traversed with innumerable canals which give it a porous appearance, and ultimately it is entirely removed, so that the sides of the artery finally cohere. The cohesion is not only where the coagulum at one time existed, but it extends also a little nearer to the heart. The artery is thus ultimately obliterated. Some observers, in describing the different exudations, name the exudation into the surrounding cellular tissue and around the artery, the external coagulum; that from the extremities of the divided coats, the middle coagulum; and that within,

the internal coagulum. In interfering with an artery, the utmost caution is necessary, not only that it may not be extensively detached from its surrounding connexions, whereby its coats would be deprived of their nutritious vessels; but also that nothing but the most gentle manipulation be employed, so that there may be as little danger as possible of the supervening action going beyond the adhesive grade.

CHRONIC ARTERITIS.

Chronic arteritis presents no distinctly appreciable signs, or they are so slight, and of so equivocal a character that they commonly escape detection, until the lesion with which they are connected has increased so far as seriously to disturb the functions of the part. The question, whether chronic arteritis stands in any casual relation to certain organic lesions, with which at one period of their history it is undoubtedly connected, will be considered, when the nature and appearances of those lesions are described.

LESIONS OF THE COATS OF ARTERIES.

CARTILAGINOUS DEGENERATION: OR, CARTILAGINOUS PATCHES UPON THE FREE SURFACE OF THE INTERNAL ARTERIAL MEMBRANE.

These formations occur most frequently before or about the middle period of life, and chiefly in the smaller arteries at a considerable distance from the heart; occasionally they are found in the larger arteries, and in such instances they occur at the point where branches originate. These deposits present considerable varieties as to their transparency, consistence, and connexion with the inner membrane; sometimes they are transparent, of a semi-fluid consistence, and separable, so that they can be peeled off, leaving the internal membrane entire; sometimes they are less transparent, of the consistence of boiled white of egg, and can scarcely be peeled off without removing that coat; in other instances, they are opaque, of the appearance of cartilage, with the lining membrane no longer discernible, and on the removal of the deposit, the middle coat is brought into view. These varieties are regarded as the different degrees of the same affection, which commences with albuminous effusion, the effusion gradually becoming more opaque and firmer in consistency, and more completely involving the internal arterial membrane. The only change these patches seem to undergo after assuming a cartilaginous consistency, is increase of thickness. The internal membrane, probably from having lost its elasticity, sometimes cracks around these bodies, which consequently hang into the artery, and in such circumstances, fibrinous coagula are apt to be deposited round their margins. Professor Hassie, of Zurich, states that he had twice found this condition in the abdominal aorta. I have, in my own collection, a beautiful preparation of the aorta, which strikingly exhibits this lesion. The opinions which at one time prevailed, that these cartilaginous patches originated between the internal and middle membranes, and that they are occasionally converted into osseous substances—that, in short, they form a preparatory stage to ossification,

are now believed to be erroneous. These opinions, no doubt, arose from the occasional occurrence of cartilaginous degeneration of the internal membrane, coexisting with osseous formation between the inner and middle coats; but the latter differ remarkably from the former in their origin, mode of development, and the consequences to which they give rise, as will afterwards be stated. As to the nature of the morbid process, by which cartilaginous degeneration of the internal membrane is produced, pathologists are not agreed. Professor Hassie thinks they are deposited immediately from the blood circulating through the vessels. Hodgson says—"The surrounding parts of the membrane generally exhibit the appearances of chronic inflammation, but I have never seen red vessels on that portion of the internal coat which had been converted into this cartilaginous structure." Bizot, who examined the arterial system in one hundred and fifty-two subjects, and minutely investigated its morbid conditions, gives a clear description of the anatomical characters of this comparatively rare degeneration of the internal coat, and regards it as a product of inflammation of that coat. It may be said to have been proved by M. Bizot, who traced the transformation step by step, that the patches originate in the albuminous exudation of arteritis, which exudation is at first of a viscid gelatinous consistence, but gradually becomes firmer, and eventually supplants the inner membrane, on the free surface of which it was originally effused.

STEATOMATOUS DEGENERATION.

This disease, named less properly by some atheromatous degeneration, was long overlooked, and seems to have been first noticed by Monro and Haller; but since they drew attention to it, it has been investigated with great success by many able pathologists, and its anatomical characters and progress distinctly pointed out. Steatomatous degeneration commences by minute granules, of a pale yellowish colour, situated between the internal and middle coats. While the disease is in this rudimentary state, the lining membrane is scarcely elevated at all; it is transparent, so that the spots are seen through it; it is unchanged in consistence; and if it be peeled off, the granules being adherent to its surface, come along with it. There is no accompanying redness, or any mark of inflammatory action in the surrounding textures. These granules coalesce into groups or masses, in the next grade of the degeneration, and the inner membrane, though unchanged as to transparency or texture, is scarcely so flat as during the early stage; and if it be peeled off, part of the deposit comes away with it, and part clings to the middle coat, from which it appears obvious, that the unnatural deposit is developed between them. The middle coat, at the seat of the deposit, is of a light yellow colour, and of a more friable texture than natural, but neither in it nor in the surrounding textures can traces of inflammatory action be at this stage discovered. The deposit has the consistence of suet—feels greasy to the touch—is of a cheese-like opaque appearance, and when broken down by the finger, gives the sensation of minute granules scattered through a fatty substance. Not only has it a fatty appearance, but the researches of Gulliver show that its chemical com-

position also differs but little from that of ordinary fat; and this being the case, of the two appellations, steatomatous and atheromatous degeneration, the former is the more correct. Bizot detected shining particles in this deposit; Cruveilhier, small masses resembling the cholesterin scales of small gall-stones. Gluge, on examining these masses with the microscope, found them to consist of fat-globules; and Sivaine, who also repeatedly examined them with the microscope, states that he "found them, on several occasions, to consist of fat-globules merely; generally, however, they were made up of an amorphous granular mass, mingled partly with fat-drops, partly with numerous cholesterin rhomboids. The shining particles are often very numerous, some having a golden, and some a silvery hue."

The steatomatous degeneration, after attaining the grade last described, may undergo one or other of various transformations; the two principal changes, however, are ulcerous softening and osseous transformation. For the sake of a clearer description, the various changes in ulcerous softening have been arranged into three stages. The first is characterized by the absence of all marks of inflammation in the surrounding textures, or of any change in colour, transparency, or consistency of the internal membrane. This membrane, however, is slightly elevated, there being more of the deposit than in the former grades of the disease; and the middle coat is still more altered and softened, and of a still brighter yellow colour at the affected spot. In the second stage, the patches are distinctly elevated, like pustules, and when pressed, communicate to the finger of the examiner the impression of their containing a semi-fluid substance. After the membrane has been opened and the matter discharged, it is found on examining the place in which the matter was contained, that the middle coat presents an ulcerated appearance; but some part of it still remains between the place in which the matter was situated and the outer coat. In the third stage, the internal membrane having cracked allows an escape of the deposit, and falls down towards the middle coat, producing a depression; or the internal membrane having (as happens in many instances) fallen off, or having disappeared, an ulcer is formed, with the walls of which the sanguineous current is in contact, the edges being irregular, and the walls formed of the outer coat, or of that and the yellowish detritus of some very small portion of the middle coat. The outer coat becomes thickened, and the seat of many injected vessels, but no traces of inflammation are to be seen in the inner and middle coats at the parts surrounding the seat of the degeneration. Such are the characters of the steatomatous degeneration, when it undergoes the ulcerous transformation; but, as has been stated above, it may undergo

Fig. 134.



Fig. 134. From a preparation in my museum.

an opposite change, termed the osseous transformation. The term

Fig. 185.



transformation has been objected to, when applied to this last-mentioned change, as the calcareous matter is merely deposited in the yellow steatomatous substance, which is regarded by many pathologists as forming its nidus. The calcareous matter assumes the form of thin, brittle scales or plates, of a yellowish-white colour, surrounded at first by steatomatous deposit, but not having any fibres or organized structures between them. They are believed to increase very slowly, the surface directed to the lining membrane more slowly than that directed outwards; and they evidently enlarge more in extent than in thickness. As the calcareous deposit increases, it comes into contact with the lining membrane, from which it is in some instances separated up to this period by a layer of albuminous matter spread over it. The inner membrane in many cases at length gives way, so that the blood is in immediate contact with the calcareous deposit, and the middle coat, after having been attenuated and changed as

already described, ultimately disappears, and its place may be said to be occupied by the concretion; hence has arisen the erroneous opinion that this coat itself is transformed into bone. The calcareous concretions are found in various forms; they usually consist of plates or scales, varying considerably in extent, and in some rare instances, occupying the whole circumference of the vessel at the affected part, so as to convert it into an inflexible tube. Sometimes they consist of minute grains; and more rarely, they give, on examination with the finger, the sensation of a number of minute bodies, movable on each other, as if jointed together. As cartilaginous degeneration of the inner coat is not very unfrequently found coexisting with the form of calcareous transformation just described, the error of ascribing the calcareous deposit to ossification of the previously-existing cartilage is easily accounted for. These subjects of anatomico-pathological investigation have occupied the attention of many pathologists, and in the present state of our knowledge of them, they are considered, not as different stages of the same

Fig. 135. From a preparation in my museum.

disease, but as entirely different diseases—the result of different morbid actions; the one commencing on the free surface of the internal coat, the other in the cellular tissue between the internal and middle membranes. Such are the anatomical characters of the ulcerous and calcareous transformations; the latter, however, may give rise to ulceration, and it may therefore be stated, that, in the progress of steatomatous degeneration, ulcerous transformation may take place, with or without osseous transformation. Sometimes when the steatomatous deposit exists in great quantity, it diminishes the channel of the artery, but it is much more frequently productive of dilatation with or without ulceration, or of rupture, or of circumscribed or diffuse false aneurism—dilatation being usually the result of the steatomatous deposit, and rupture with its consequences, of that condition when accompanied by calcareous concretion. A variety of the steatomatous deposit has been described by Scarpa, Stentzel, Craigie, and others, in which the secretion is of a yellowish colour, and of a cheesy or wax-like consistency. It commences most frequently in the bifurcations of arteries, and originates between the middle and inner coats; but it differs from the deposit already described, in being of firmer consistence, and in rarely containing gritty calcareous deposition. To this variety some restrict the term steatomatous degeneration, and give to that already described the name of atheromatous deposit.

CALCAREOUS DEGENERATION.

Calcareous degeneration has been referred to by authors under the various names of ossification, earthy degeneration, calcareous deposit, and osseous transformation. One variety of this disease, namely, that which is often found to occur as a transformation in the progress of steatomatous degeneration, has already been described; but there is another form, differing from this in many important particulars. Its seat is in the middle coat itself; it appears in the form of plates or spicula, occupying a greater or less extent of vessel, and in some examples, it at last becomes so extensive and complete as to convert the affected part of the artery into an inert tube. This degeneration seldom affects the whole circumference of an artery, except in the lower extremities, where it has been found to exist in distinct rings. The middle coat loses its equable aspect, some of its fibres shrivel, and the coat consequently becomes thin. It is yellower than natural, and instead of being elastic, it becomes friable and easily torn. If at this period, the vessel be cut in the direction of its length, the margins of the incision appear irregular, from the change not having been uniform, some fibres having lost more of their elasticity than others. Such are the early deviations from the healthy appearance of the middle coat, the fibres of which are ultimately changed into, and their place occupied by, an osseous formation. In consequence of this change, the external surface of the artery, in many instances, presents an uneven appearance, becoming unequally dilated in some parts, and slightly constricted in others. The internal coat, while the disease is limited and of recent standing, may remain entire, though shrivelled and irregular; but in an advanced stage, the inner surface of the vessel often becomes ragged and irregular—a result of the rupture of the internal membrane at the

margins of the calcareous deposit. The morbid change now under consideration is most frequently found in the arteries of the lower extremities and of the brain; and the steatomatous degeneration most frequently in the aorta. Dilatation and aneurism are more rarely caused by the calcareous than by the steatomatous degeneration. In individuals at an advanced period of life, the calcareous degeneration not unfrequently produces in the lower extremities gangrene of feet and limbs, and in the vessels of the brain rupture, ending in fatal extravasation of blood and compression of the brain. Another consequence of this degeneration is hemorrhage after the deligation of an artery; the vessel cracks at the part where the ligature is applied, adhesion does not follow, and ulceration and hemorrhage result. The steatomatous degeneration and its various sequelæ are occasionally coexistent with the calcareous. Although the calcareous deposition is a form of ossification, yet it differs from bone in several essential particulars; it is destitute of fibrous structure and of vascularity; it presents an irregular homogeneous appearance; it consists of a larger portion of phosphate of lime and less animal matter; and it is destitute of any obvious arrangement. The period of life at which calcareous degeneration usually occurs is after the sixtieth year. Instances, however, are recorded, of its having been met with in infants, in children, and in persons from eighteen to twenty-four years of age; but such examples are regarded as exceptions, and are extremely rare. As increased vascular action frequently exists without calcareous degeneration, and as that degeneration, in its early stage, is unattended with any traces of inflammation (although, when extensive, it may operate as a foreign body, and excite chronic inflammatory action), there appears no reason to regard this disease as a consequence of inflammation; especially as it usually occurs at that period of life at which there is the least tendency to inflammation. It is considered to be a result of an alteration of the process of nutrition, but with what morbid condition of the system it is connected, pathologists have not been able to determine.

ANEURISM.

By the term aneurism, derived from the Greek *ἀνέρισμα*, signifying a dilatation, is meant a pulsating tumour containing blood, and communicating with the interior of an artery.

I. *Divisions.*—Various divisions have been made of aneurisms. Some writers, taking situation as the basis of arrangement, have divided them into internal, or inaccessible; and external, or accessible. By an external or accessible aneurism is meant an aneurism so situated, that it is impossible to include the trunk of an affected artery in a ligature, between the aneurism and the heart: where this is impossible, the aneurism is termed internal, or inaccessible. To the latter class belong aneurisms in the cavities of the body, as in the abdomen, chest, and cranium. Another division is based on the manner in which the aneurism is formed, and the tissue constituting the aneurismal sac. According to this arrangement, which is both ancient and useful, all aneurisms may be arranged into two classes—true and false. Much confusion, however, has arisen from systematic writers attaching different meanings to these terms. By a true aneurism, some authors mean one in which the aneuris-

mal sac is formed by simultaneous dilatation of all the coats of an artery; and by a false aneurism, one in which, after the destruction of the inner and middle coats, and the ultimate giving way of the outer coat, some other tissue forms the aneurismal sac. Other writers, by a true aneurism, mean one which results from disease of an artery, and formed by dilatation of all the coats, or in consequence of ulceration from within, or by rupture, or by ulceration and rupture jointly, while some of the coats, remaining undivided, form the aneurismal sac; by a false aneurism, they understand one in which some other tissue, or tissues, form the aneurismal cyst, all the coats having been divided by a wound, or destroyed by ulceration from without. Another classification, adopted by many writers, divides aneurisms into true, false, and mixed; the true being those in which all the coats are dilated and form the sac; the false, those in which all the coats are destroyed at some part, and the surrounding tissues form the cyst; and the mixed, those in which the coats of the vessel are first dilated and subsequently destroyed, the disease being at first a true, and afterwards changing into a false, aneurism. Cruveilhier, from finding the imperfections of other classifications and of the difficulty of ascertaining beyond doubt the state of the arterial coats, by which alone could be formed a classification founded on a pathological basis, proposed an arrangement based entirely on outward form; namely, A. Aneurismes sous l'aspect d'ampoules; 1. Aneurismes Périphériques; 2. Aneurismes Sémipériphériques; 3. Aneurismes à Bosselures. B. Aneurismes sous l'aspect de Poches à Collets.

TRUE ANEURISMS.

II. *Mode of Formation.*—True aneurisms may be formed in various ways:

1. *By Dilatation.*—It has been clearly proved by various dissections, in which the true arterial coats have been traced in unbroken continuity through the parietes of the sac, that aneurisms are sometimes formed without any rupture by dilatation of all the coats. This doctrine, advanced by Fernellius, Diemerbroeck, Haller, and others, was called in question by Scarpa, who conceived that true aneurisms are always formed by destruction of some of the tunics of an artery. The opinion of Scarpa, however, was successfully combatted by Hodgson, who by minutely examining numerous preparations in the different museums in London, and by carefully dissecting many aneurisms in their different stages of formation, ascertained that although in the majority of instances, especially when aneurisms have attained a considerable size, the coats of the vessel have given way, still many aneurisms are formed by dilatation, and that Scarpa therefore was on this point certainly in error. The dilated coats in some instances appear little altered in thickness, but more frequently they are attenuated in some parts, and thickened in others. The dilatation may affect only a limited portion of the circumference of the artery, constituting what from its form is called a sacculated or sacciform aneurism; or it may implicate the whole circumference and affect the artery to a considerable extent longitudinally, constituting when regular in its outline and abrupt at its extremities, a cylindrical aneurism; or it may commence and terminate gra-

dually, in which case it is called a fusiform aneurism ; or it may be very irregular, giving to the artery a knotty and tortuous appearance, constituting what Breschet has denominated the varicose form of true aneurism. The formation of aneurism by dilatation is often observed in the aorta.

2. *By Rupture.*—If an artery, affected with any of the forms of degeneration formerly described, be violently stretched, as in leaping, running, or by any violent exertion in walking, then the inner and middle coats may become lacerated, the diseased condition may prevent adhesion, and the result may be the dilatation and ultimately the giving way of the outer coat. The doctrine that aneurism was formed by rupture of the coats of an artery was maintained by Sennertus, Hildanus, Severinus, and others. It is usually called, however, the doctrine of Sennertus, and has been ably supported by Scarpa, who contended that aneurism is formed “by a corrosion and rupture of the proper coats of the artery, and consequently by effusion of blood under the cellular sheath, or any other membrane which covers externally the injured artery.” Aneurisms formed in this way are not unusual in the extremities, more especially at the flexures of the joints ; and they are more frequent in men than in women, probably because the exciting causes of their formation are such as the former are more exposed to than the latter. In most instances, the rupture of the coats is attended with sharp pain, and many patients have stated, that they felt as if they had received a smart blow on the part, and have been able from this circumstance to date the commencement of the disease. Rupture does not appear ever to take place in a sound artery, and if it did, the experiments of Jones prove that it would not be followed by an aneurism, as an effusion of lymph takes place, by which the vessel is strengthened at the injured part.

3. *By Dilatation and Rupture.*—Cases recorded by Lancisi, Friend, Guattani, Morgagni, Monro, and many subsequent observers, leave no doubt that aneurism may arise from dilatation and rupture conjointly ; and in the opinion of many distinguished pathologists, this is the most frequent mode of its formation. There is first a dilatation of all the coats, forming a true aneurism ; but when the expansion reaches a certain point, the inner and middle coats, having less power of extension than the outer, become ruptured or give way, either after or without previous ulceration ; and the outer coat becomes distended and forms a sac which surmounts the primary dilatation. The expansion of all the coats constitutes a true aneurism, which may be termed primary ; the dilatation of the outer coat forms a consecutive aneurism. Such cases have been denominated compound or mixed aneurisms. The peculiarity of this mode of formation is, that rupture or ulceration of the internal and middle coats takes place after their dilatation, and is followed by a still farther dilatation of the outer coat. Examples of this form of aneurism occur not unfrequently in the aorta. The above are the principal changes in the coats of arteries constituting aneurisms ; and they may all be said to proceed from pre-existing changes connected with the cartilaginous steatomatous or calcareous degenerations, or with these conjointly ; or the pre-existing change may, in some instances, consist only of a low grade of inflammation causing debility and defective vital

cohesion of texture,—common results of inflammation in many other textures of the body. There can be no doubt, however, that the steatomatous degeneration is by far the most frequent predisposing cause of aneurism, and the rationale of its operation may be very easily understood from what was stated, in a former section, as to the conditions to which it gives rise. If the degeneration be confined to a particular part, and implicate only one side of an artery, it is easy to conceive how, on the destruction of the elasticity of the inner and middle coats, the column of blood acting with equal force on every side will give rise to a dilatation or pouch on one side, constituting a sacciform aneurism. If the degeneration extend around the whole circumference, and be abrupt at its commencement and termination, the distending force may cause a cylindrical aneurism; whereas, if the transition from the healthy to the diseased state be more gradual, a fusiform aneurism will more probably be the result. As has been already stated, any of the various degenerations of the coats, or a low grade of inflammation may constitute the pre-existing change which predisposes to the formation of aneurism. The steatomatous degeneration is by far the most frequent, the true calcareous degeneration of old people comparatively rare. The latter, however, may lead to the formation of aneurism by causing rupture or ulceration of the inner coats, or the narrowing of the arterial canal, which it occasions, may be followed by dilatation on its cardiac side, leading to the giving way of the inner and middle coats.

The three modes of formation, then, are—by dilatation alone, by rupture alone, or by dilatation and rupture conjointly.

III. *Varieties.*—Besides the differences of form which have led to the appellation of sacciform, fusiform, cylindrical, and varicose, and the differences in the kind of degeneration which may constitute the pre-existing change, true aneurisms (using that expression in the sense already affixed to it) present numerous varieties in the condition of the several coats of the artery and their relation to the aneurismal sac.

The principal varieties are the following, the first four of which are illustrated by Wardrop, by the accompanying diagrams.

First diagram.



Second diagram.



Third diagram.



Fourth diagram.



1st. The parietes of the aneurismal sac may be formed by the distension of the three coats.

2d. They may be formed by the dilatation of the internal and external coats, the middle coat having been ruptured.

3d. They may be formed by the dilatation of the external coat, the middle and internal coats having been ruptured or destroyed by ulceration, or by rupture and ulceration.

4th. They may be formed by the dilatation, or hernia, of the internal coat, the external and middle coats having given way.

This rare variety, examples of which have been observed by Haller,

Dupuytren, Dubois, Breschet, Laennec, and Liston, has been hitherto regarded by most observers as peculiar to the aorta, the inner membrane of which is more loose and elastic than that of other parts of the arterial system; but Breschet conceives that he has proved its occurrence in smaller arteries. It probably arises from the destruction of the external and middle coats by disease, and according to Laennec, the inner coat will protrude and form an aneurismal sac while the swelling is small, but will be apt to burst, as the tumour becomes larger. Laennec refers to four examples, in two of which the aneurisms were of the size of cherries, and the inner membrane, though dilated, was entire; in the other two, they were of the size of walnuts, and the inner coat had given way. Laennec says—"The opinion at present current in the Parisian schools, viz., that in aneurism the internal coat remains entire, and protrudes in the form of a hernia, through the ruptured fibrinous tunic, is more untenable as a general position than that of Scarpa, who maintains the rupture of the two internal tunics in every case of the disease. Both these opinions are true in certain cases, but not in all." John Hunter, Scarpa, and Sir Everard Home, removed the external and middle coats of arteries in various experiments on living animals, with the view of ascertaining whether the force of the circulating current would dilate the inner coat into an aneurism; but they found that instead of an aneurism resulting, effusion of lymph took place, and the part healed without any change of size in the channel of the artery.

5th. The *dissecting* is a very rare variety. Laennec has given an account of one example, and Mr. Guthrie of two. In the case mentioned by Laennec, the aneurism was very extensive; yet the person was not suspected, during life, of having any disease of the vascular system. The aneurism extended from the arch of the aorta to its division into the common iliacs, and is the largest example of this variety on record;—"The internal and middle coats had been divided by a narrow transverse fissure, extending over two-thirds of the circumference of the artery; and the blood, instead of extending the external coat into a sac, had insinuated itself between it and the middle fibrous coat, and dissected them from each other, through more than half the circumference of the artery, from the arch of the aorta down to the common iliacs." Here the aneurismal sac was formed on one side by the external coat, and on the other by the middle and internal coats. In one of the cases recorded by Mr. Guthrie, there was a fissure about half an inch in extent, by which the blood escaped through the inner and middle coats, and effected a separation of the middle and external coats, so as to form a pouch about six inches in length in the anterior part of the descending aorta. In the other example mentioned by Mr. Guthrie, the inner and middle coats of the aorta were divided along half the circumference by a very clean rent, situated opposite to the origin of the *arteria innominata*, and the separation of the external and middle coats extended on the one side from the rent to the origin of the aorta, and on the other to a point opposite to the origin of the left subclavian. Laennec was the first writer who gave a minute description of this curious variety, and it has been carefully investigated by Rokitsansky,

who gives an account of eight cases which came under his own observation. These eight, together with two others, also referred to by Rokitsansky (viz. the one described by Laennec, and one by Dr. Stosch), the two described by Guthrie, two by Mr. Smith, one by Nivet, and two by Goddard and Pennock, being seventeen in all, were, until lately, so far as I know, the only recorded examples of this kind of aneurism. In almost all these examples the heart was diseased, and more especially its left side; in some instances there was dilatation with hypertrophy; in others dilatation with attenuation; and in many of them there were evident signs of steatomatous and calcareous deposits. According to Rokitsansky, it sometimes commences by disease of the middle and internal coats, in which case the continuity of these coats is destroyed, and the separation of the external coat follows as a later effect; in other instances, it is the consequence of chronic inflammation of the external coat, which gives rise to separation of that coat, followed by rupture of the middle and internal coats. In the one set of cases he considers that the rupture precedes, in the other, that it follows, the separation.

6th. The late Mr. Shakelton described a kind of aneurism previously unnoticed, in which the blood had forced its way through the internal and middle coats, dissected the middle from the external coat to the extent of four inches, and then burst again into the channel of the artery, thus forming a new channel, which eventually superseded the old one,—the latter having been obliterated by the pressure of the tumour. In this case the aneurismal sac was formed by five coats on the one side, and the external coat on the other.

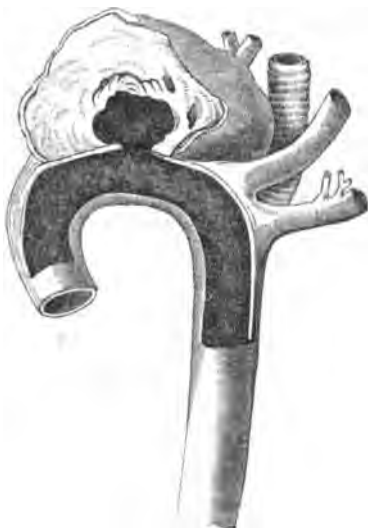
7th. In the body of a man about fifty years of age, who had not been supposed to be the subject of any disease, and who died very suddenly before any medical man had an opportunity of seeing him, I met with a singular variety of dissecting aneurism. In the arch of the aorta, about three-fourths of an inch to the left side of the origin of the left subclavian artery, there was a rent of the inner and middle coats; from this rent to near the origin of the aorta on the cardiac side, and for upwards of an inch on the capillary side the external coat was separated from the middle, round nearly two-thirds of the circumference of the artery. There was an opening upwards of half an inch in diameter, by which the aneurism thus formed burst into the pulmonary artery, a little below the place where that vessel gives off its two branches. The aorta was affected with steatomatous deposit in many places, and in this case there were, beyond all doubt, patches of the same kind of degeneration in the pulmonary artery. There was very slight hypertrophy of the left side of the heart.

A true aneurism is invariably limited at first; that is, it is confined within a proper cyst; but, by rupture or ulceration, the cyst may give way, and the blood become diffused through the surrounding textures; in which case the aneurism is said to be diffuse.

IV. *Contents of the Sac.*—The contents of an aneurismal sac are not the same at all periods; they vary considerably, according to the length of time that has elapsed since the commencement of the disease. At first the sac contains only fluid blood, and in this stage, by exerting

pressure on the swelling, or on the artery leading to it, the aneurismal sac is readily emptied. In the next stage the contents consist partly of

Fig. 186.



fluid blood, and partly of a solid substance, the nature of which will be afterwards described, bearing but a small proportion to the fluid. In a yet more advanced stage, the sac still contains both fluid blood and coagulum; but the proportion of the latter to the former is greatly increased. When after death an opportunity is afforded of examining an aneurism of some standing, the sac is found to contain what is technically called the coagulum, consisting of two parts, namely, blood more or less firmly coagulated, the coagulation having probably taken place subsequent to death, and a lamellated fibrinous concretion. This fibrinous concretion is found to consist of numerous concentric laminæ, varying in firmness according to their situation; those

nearest to the blood having usually a soft and somewhat reddish appearance; those farther removed being more dry, more pale, and more adherent; and the external ones in contact with the sac, having a very opaque, dry appearance, and being of a somewhat friable consistence.

A most important change which takes place soon after the occurrence of aneurism, is the commencement of the formation of the fibrinous concretion. The blood, after the formation of the aneurism, leaves upon the internal surface of the sac a layer of coagulum, and this being followed by successive depositions of fibrin, the lamellated concretion is gradually formed. If the form of the sac be such as to admit of the retardation of the current of circulation in it, as in a sacculated aneurism, having a narrow communication with the arterial trunk, the coagulum is formed much more readily: and this explains a most important difference in the pathological conditions of an aneurism, and a simple dilatation of the artery; for in the latter, where the surface is smooth, and no retardation of the current of blood can take place, there is no fibrinous concretion, and consequently no means of protection for the weakened part.

V. *The various ways in which Aneurisms prove fatal.*—1. Aneurisms frequently prove fatal by making their way to the surface of the body, or to the mucous canals, or to the serous cavities. When an aneurismal tumour reaches the surface of the body, it never bursts by laceration,

Fig. 186. Farther growth of aneurism prevented by coagulum becoming adherent to the artery around the opening of the sac. From Hodgson.

but the attenuated integument sloughs, and on the separation of the slough, an escape of blood takes place. The flow of blood is for a time arrested by a part of the coagulum forming a plug, but by and by, the hemorrhage returns, and the patient sinks in consequence of repeated attacks of it. The process is the same when the disease opens into the mucous canals, or into an organ lined with a mucous membrane, as the œsophagus, intestines, or bladder. The part does not give way by laceration, but after being attenuated by absorption, it is destroyed by sloughing. I have a preparation of an aneurism of the aorta, in which an opening was made into the trachea by the process above referred to, and the first discharge of blood caused death by suffocation.

Aneurisms frequently prove fatal by bursting into some of the serous cavities, as the cavities of the pleuræ, that on the left side more frequently than that on the right, the peritoneum, the serous cavity of the tunica arachnoidea, or the pericardium. Of the last, examples were seen by Morgagni, Sir Astley Cooper, and others; and I have a beautiful specimen taken from a man who died suddenly, in whose pericardium I found a large quantity of blood, the fatal rent being about an inch in length. In the two former modes of fatal termination, the integument, or mucous membrane, after being attenuated by absorption, gives way by sloughing; in the last the serous membrane gives way by a rent. In the third mode, and sometimes in the second, death results from a single discharge of blood; but in the first, from repeated hemorrhages.

2. Death may be caused by pressure on important parts, as the trachea, the bronchial tubes, the lungs, the œsophagus, the thoracic duct,

Fig. 137.



Fig. 138.

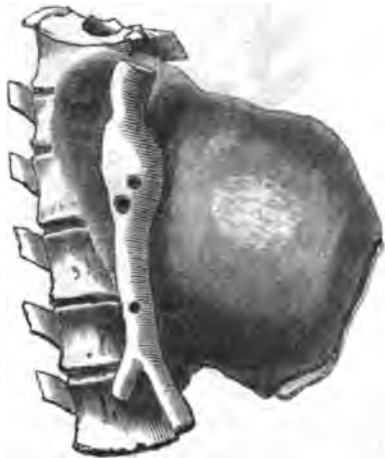


Fig. 137. Aneurism of arteria innominata, which proved fatal by bursting into the trachea. From a preparation in my own museum.

Fig. 138. Aneurism of the aorta, which induced caries of the vertebrae, and fatal compression of the spinal cord. From a preparation in my museum.

of which Laennec witnessed an example, or the spinal cord. I have several specimens of aneurisms which proved fatal by pressure on the spinal cord; in one of them the bodies of two vertebræ, and in another those of three, are entirely absorbed on the left side of the spine.

3. By constitutional irritation, the system sympathizing with the local irritation. This will be most likely to occur when the aneurism is surrounded by unyielding textures, which are capable of offering considerable opposition to its integument.

4. Aneurisms may prove fatal in consequence of inflammation attacking the sac and surrounding parts, and giving rise to suppuration and the formation of large abscesses. This is by no means a frequent occurrence, but various examples are on record.

5. Death may ensue from the bursting of the aneurism, and the escape of blood into the surrounding textures, that is, from a circumscribed aneurism becoming diffuse. The extravasated blood may so greatly interrupt the circulation as to cause gangrene, or the infiltration may be followed by unhealthy inflammation of the tissues, which are weakened by the pressure of the infiltrated blood, and death may be caused by the symptomatic fever, which in such cases usually assumes a typhoid type.

Such are the most frequent modes of fatal termination of aneurisms; there are others which, though of extremely rare occurrence, are occasionally met with. In an individual not suspected of labouring under

Fig. 139.



Fig. 140.



any disease, who died instantaneously one morning, while rising out of bed, and whose body I was requested to examine, death was caused by an aneurism of the aorta bursting into the right auricle of the heart. This mode of fatal termination has also been seen by others. I have

Fig. 139. Front view of aneurism of aorta. From a preparation in my museum.

Fig. 140. Back view of same preparation, showing the aneurism, producing absorption of the ribs, and making its way to the surface. Death was caused by part of the coagulum falling into the artery.

in my possession a specimen taken from a case in which death was caused by an aneurism of the aorta making its way into the pulmonary artery. In some instances of aneurism of the aorta, it has been found on dissection, that fatal destruction of the circulation resulted from a portion of the coagulum falling from the sac into the artery.

VI. *Symptoms.*—Sir Astley Cooper says, “With respect to external aneurisms, the symptoms may be divided into three stages. When you have an opportunity of seeing aneurism in its early stage, you will find a small tumour pulsating very strongly—much more strongly than in any subsequent stages; for it may be taken as a general rule that the force of the pulsation is in the inverse proportion of the size of the aneurism. When an aneurism is first formed, it contains only fluid of blood; and if you apply your finger to the artery between the aneurism and the heart, you will readily empty the aneurismal bag. In this state there is scarcely any pain, and no other alteration in the limb than some irregularity of circulation producing spasm in the muscles; and when the patient is going to rest, cramps in the legs and sudden twitchings, which prevent him from sleeping. The next state in which we find aneurism is when the blood is beginning to coagulate in the interior of the sac, the coats of which are very considerably thickened. At this time, if you press on the artery, you may empty the sac in part; you will see the swelling reproduced when you take off the pressure. You cannot completely empty the bag by pressure, for a considerable degree of swelling will still remain. There is some degree of pain in the limb below in this stage of the disease, in consequence of the size of the swelling, and the pressure on the surrounding parts. The aneurism becomes a solid swelling, instead of a mere bag containing fluid blood, and the circulation is retarded by the pressure on the surrounding parts. In the next stage, the aneurism has acquired considerable magnitude, and the pulsation is, in a great degree, lost. Pulsation may be observed in some one part opposite to the opening from the artery, but it is seldom perceived over the whole swelling. A small portion of the blood still continues in a fluid state, but the greater part of it is filled with coagulum.”

The principal symptoms of external circumscribed aneurism are a swelling, pulsation synchronous with the heart's action, and at each pulsation an elevation of the tumour, a heaving or uniform enlargement, a peculiar thrill felt on applying the hand, and a sound like that of bellows perceptible on applying the ear. For the purpose of diagnosis, it is of the utmost importance that the characteristic peculiarities of these symptoms should be clearly understood.

1. *The swelling* at first is small, but its increase is gradual; “seldom so rapid as the outward bulging of an abscess; seldom so tardy as the enlargement of any tumour not malignant.” In the first stage it is

Fig. 141.



soft, and may be reduced by pressing the tumour or the artery leading to it; in the second stage it is a little harder and less compressible; and in the third stage it is still harder, and very slightly, if at all, susceptible of diminution by pressure. To whatever extent the tumour may be compressible, it immediately returns to its former size on the discontinuance of the pressure. By pressure on the trunk, leading from the aneurism, the tumour is increased.

2. *The pulsation* is synchronous with the action of the heart, and is much more perceptible, both to the touch and the sight, in the first than in any subsequent stage. In the second stage the pulsation, in consequence of the deposition of fibrin, may be less distinct in certain parts of the tumour than in others; hence it is said not to be "equal in all directions." In the third stage the pulsation is still further diminished, and may be limited to certain parts; and it is scarcely, or not at all, perceptible if the sac be nearly filled with lamellated fibrin. The absence of pulsation, therefore, is no certain proof that a tumour is not an aneurism; nor is the presence of pulsation any proof that it is; for a tumour or an abscess may have pulsation communicated to it by its being situated over an arterial trunk, and in the case of an abscess so situated, the fluid nature of its contents renders the pulsation very deceptive. It will assist in diagnosis to remember, that the pulsation of an aneurism cannot be changed by any alteration in the position of the limb; but that the pulsation communicated to a tumour in the neighbourhood of an artery, may be diminished or suspended by placing the limb in such a position as may remove the tumour from the artery, or by lifting the tumour off the artery, or pressing it aside.

3. *Elevation* of the aneurism is perceptible, and is always synchronous with the pulsation.

4. A *heaving*, or *uniform enlargement*, or *distinct expansion at every point*, simultaneous also with the pulsation, is quite diagnostic of aneurism. The impression communicated to the fingers of the examiner is, that the expansion is caused by the injection of a fluid into the cavity. This symptom differs very much from the pulsation or change of place of a tumour occasioned by an impulse from a neighbouring artery. The presence or absence of this symptom should be minutely inquired into, in the examination of every swelling supposed to be aneurismal.

5. The *peculiar thrill* or rasping sensation, felt on placing the fingers over the aneurism, is supposed to be produced by the blood rushing over a rough surface.

6. The *sound, like that of a bellows (bruit de soufflet)*, is discoverable either by mediate or immediate auscultation. This sound, however, is no certain proof of the existence of aneurism, as it is well known that it may be produced by a tumour diminishing the calibre of an artery; it may be made perceptible by compressing an artery with the stethoscope, more especially if the individual be in a state of nervous agitation; and it has often been perceived where, on dissection, no lesion of the coats of the arteries could be discovered.

Of all the symptoms, the uniform expansion simultaneous with pulsation, is the most unequivocal. The history of the symptoms often affords valuable assistance in making out the diagnosis in difficult cases.

The following symptoms, though not distinctive characters, usually in a greater or less degree attend aneurism, at some period of the disease.

Pain.—If an aneurism arise from dilatation, there is usually no pain at the period of its formation; if there be first dilatation and then rupture, the pain is trivial; but if the aneurism originate in rupture, sharp pain is felt at the formation of the disease; and in all cases there is ultimately more or less pain or uneasiness, when the swelling attains great size in an advanced period of the disease.

Edema of the extremity, weakness, numbness, spasmodic twitchings, and sensations from compression or stretching of surrounding structures, are symptoms of frequent occurrence. If an aneurism be in the neighbourhood of a joint, it usually interferes to a considerable extent with the motion of the articulation.

VII. *Spontaneous Cure.*—Nature sometimes, though very rarely, effects a cure; and an aneurism, therefore, which is not accessible to surgical treatment, does not invariably terminate fatally. The processes by which a spontaneous cure may be effected are the following:—

First.—The most frequent manner of a spontaneous cure is, by the sac becoming filled with lamellated coagulum. The various stages of this mode of favourable termination, first minutely described by Hodgson, and afterwards minutely investigated by many other competent observers, are the following:—the sac becomes completely filled so as to preclude all further entrance of blood. The artery, by deposition of coagulum, becomes impervious as far as its nearest considerable branches, and is ultimately converted into a small impervious cord,—the circulation in such cases being maintained by the blood, which is received into the branches given off from the arterial trunk above the aneurism, being discharged into branches given off from the trunks below, and conveyed through the last-mentioned branches by inverted circulation into the trunks from which they originate—both sets of branches becoming much enlarged. Or the artery may remain pervious, the blood passing over the closed-up sac at the part where its mouth communicated with the vessel. The tumour becomes smaller and harder in consequence of absorption. Petit records a case of spontaneous cure, in which the aneurism, at one time as large as an apple, became as small as an olive. Examples of this mode of spontaneous cure are to be found in the writings of most sur-

Fig. 142.

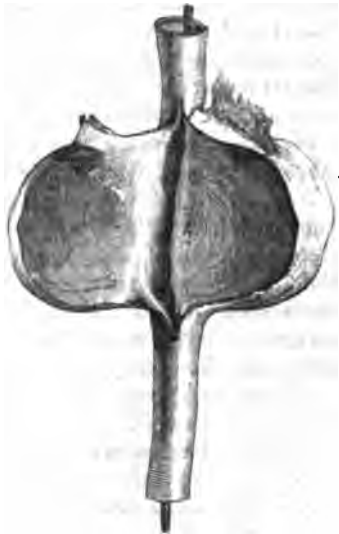


Fig. 142. Spontaneous cure of aneurism of the femoral artery by the sac being filled with coagulum; the vessel remaining pervious. From a preparation in my museum.

gical authorities on this subject. The accompanying drawing is taken from a very good example in my own collection of preparations.

Second.—In some examples where the whole circumference of a vessel has become aneurismal, a spontaneous cure has been effected by a canal being left through the centre of the lamellated coagulum, through which the blood continued to circulate. There is reason to believe this to be an extremely rare mode of spontaneous cure.

Third.—It occasionally happens that from over-distension, or some other circumstance, inflammation of the sac and surrounding parts supervenes, and goes on to gangrene, the whole of the aneurismal tumour sloughing away, and by that means a spontaneous cure is effected;—hemorrhage from the vessels leading to the part being prevented by the same process as when gangrene takes place in other circumstances.

Fourth.—Another mode is by the aneurism pressing on the trunk leading to or from the aneurism, so as to obstruct the circulation. If the size and position of the tumour be such as to cause an approximation of the opposite sides of the artery either on the cardiac or capillary side, there can be no doubt that a cure will be the result. When the pressure is on the cardiac side, the cure is effected on the same principle as in one of the modes of surgical treatment described in the next section.

Fifth.—Pressure on the trunk leading to the aneurism may be produced by other causes than the aneurism itself, as by a tumour not aneurismal, or by another aneurism on a neighbouring artery; and thus a spontaneous cure may result. Mr. Liston records an example of subclavian aneurism, which on dissection was found to have been cured by an aneurism of the arteria innominata.

Sixth.—The same favourable result will follow, when inflammation takes place in the artery, and fills its calibre with coagulum.

Seventh.—Sometimes a portion of lamellated fibrinous coagulum becoming detached falls into the sac, and thus causes diminution, or complete occlusion of the mouth. In the latter case, coagulation of the blood in the sac must take place, and in the former the consequent diminution of the circulation through the sac is much calculated to promote deposition of fibrin, and to accomplish a spontaneous cure. In this mode the artery may or may not become impervious.

Eighth.—A portion of the coagulum may fall into the artery and obstruct it, thus effecting a cure. Or,

Ninth.—The aneurism may burst and become diffuse. If the presence of the diffusely infiltrated blood do not give rise to the untoward consequences formerly described, it may, by its pressure on the cardiac side of the tumour, so weaken the force of the circulation through the aneurism, as to promote the deposition of lamellated coagulum, or to arrest the circulation of the fluid parts of the contents of the sac, and thus promote their coagulation. Such are the methods by which nature sometimes, though rarely, effects a spontaneous cure; and it may be a consolation to patients who are subjects of aneurisms in inaccessible situations to know that their case is not hopeless, and that a spontaneous cure is not impossible.

VIII. *Treatment.*—As the enlargement and ultimate giving way of

an aneurism depend on the force with which the current of blood is sent into the sac, leading principles in the treatment have been, to diminish this force, or to arrest the current altogether. By fulfilling the first indication, the progress of the disease must be retarded, and its cure may be effected, as the diminution in the velocity and force of circulation promotes the formation of lamellated coagulum; by the second indication, a cure is effected, for the fluid contents of the sac being set at rest become coagulated. Consolidation induced by coagulation, or by deposition of fibrin, or by both, will be followed by increased hardness, diminution by absorption, and the other favourable symptoms mentioned in the description given of the first mode of spontaneous cure.

The *medical treatment*, which is the only treatment practicable when the aneurism is in the cavities, or in situations inaccessible to the surgeon, is useful on the principle already stated, that the diminution of the force and velocity of the circulating current increases the tendency to deposition of coagulum. This diminution is effected by lessening the vigour of the heart's action and the quantity of the circulating fluid. For the attainment of these objects, the vigorous employment of antiphlogistic treatment, to as great a degree as is compatible with the continuance of life, was originally proposed and practised by Albertini and Valsalva. It is designated their treatment of aneurism, and from their experience and that of others it acquired great celebrity, which, however, it has not maintained. Albertini and Valsalva reduced their patients, by repeated abstractions of blood, to such an extreme degree of debility, that they could scarcely raise their arms from bed; they enjoined the most perfect quietude both of body and mind; they directed that their patients should be kept constantly in the horizontal posture in bed, and that their diet should be of the most unstimulating kind; and they gradually reduced the quantity to half a pound of pudding in the morning, and a quarter of a pound in the evening, forbidding everything else except a limited quantity of water. When this treatment effected a cure, it was by favouring the deposition of lamellated fibrinous coagulum. Its efficiency in arresting the progress of internal aneurism and accomplishing its cure, has been proved by the experience of Albertini, Valsalva, Pelletan, and other observers; but there is reason to believe that its effects have been very much overrated. Be that, however, as it may, few persons will submit to its employment to the extent practised by Albertini and Valsalva; and there can be no doubt that it has often been used to a hurtful extent, and that in some persons it is not free from the danger of proving fatal by inducing other diseases. Its employment is, therefore, often inadmissible. For these reasons, it is not now adopted in the vigorous manner practised by Albertini and Valsalva, nor with a curative view, but in a very modified form, and with little hope of doing more than checking the progress of the disease. By medical treatment alone, can the progress of aneurisms in inaccessible situations be retarded; and of the necessity of employing all judicious means for diminishing the circulation, and of endeavouring to preserve the body in a quiescent state there can be no reasonable doubt. Although it may not be prudent to reduce the patient to a state of great debility, there can be no question that it is advisable and

necessary in every case of internal aneurism to enjoin quiet, restriction of diet, abstinence from animal food, and from all stimulants; to caution patients that they guard against all emotions of mind, and refrain from every kind of exercise by which the circulation could be accelerated; and occasionally to have recourse to bleeding, proportioned in frequency and quantity to the force of the circulation, and the strength of the patient. A precaution which ought always to be observed is, to withdraw the blood slowly from the patient placed in the horizontal position, and never to take away a large quantity at once, lest syncope should be induced, which in internal aneurism, more especially if there be disease of the heart, is attended with the greatest danger. Digitalis, from its effect of weakening the action of the heart, has often been administered; but its employment is a matter of very questionable propriety, as the extent to which it affects the heart's action cannot be regulated with certainty, and its decided influence is hazardous in such cases. The superacetate of lead has long been used in Germany in cases of internal aneurism; and Laennec, Dupuytren, and Bertin in France, and some practitioners in this country, state that they consider it to have been used with advantage.

Surgical Treatment.—Until John Hunter, in 1785, proposed and practised his operation for the cure of aneurism, the treatment adopted was either amputation, or the employment of pressure, or the performance of some one or other of the following operations.

One of the earliest operations we read of is that which was practised in the time of Celsus, who lived in the beginning of the first century of Christianity, and was the most elegant writer on medicine and surgery among the Romans. In those days the practice was to open the tumour, to clear out its contents, and to endeavour to stop the hemorrhage by thrusting the actual cautery into the wound—a procedure almost invariably fatal, and it would have been very surprising if it had been otherwise.

Another operation is that which was practised by Rufus the Ephesian, a zealous surgeon who flourished in the beginning of the second century in the time of the Emperor Trajan. He first by means of a ligature secured the artery immediately above the aneurism, and then cut into the tumour and removed its contents.

Antyllus, who is generally believed to have flourished in the beginning of the fourth century, followed the example of Rufus in cutting into the aneurismal swelling, and removing its contents; but he previously tied the artery below, as well as above the swelling, and endeavoured to heal the wound by granulation.

Such were the operations practised among the Romans.

The Greek and Arabian writers recommended an operation in some measure different from those practised among the Romans, and, in one particular, bearing a resemblance to that in use at the present day.

Aëtius, a native of Amida, and a pupil of the celebrated School of Alexandria, who flourished in the middle of the sixth century, and the celebrated Paulus Ægineta, also a pupil of the Alexandrian School, who lived about the middle of the seventh century, both practised the same operation. Aëtius recommended for the cure of aneurism at the bend

of the arm, to include the brachial artery in a ligature a little below the axilla, and then to evacuate the contents of the aneurism: the peculiarity of this method was the application of the ligature at a considerable distance from the aneurism. Paulus Ægineta not only practised this operation for the cure of aneurism at the bend of the arm; but adopted it also in aneurisms in various other situations.

Such was the practice recommended by the Greek writers.

These operations were succeeded by one still more formidable and dangerous, which consisted in opening the aneurismal sac, clearing out its contents, then searching for the artery and securing it by a ligature, both above and below, at its openings into the sac. This horrible and dangerous procedure was always attended with extreme pain and irritation, and was for the most part fatal, as might have been anticipated, considering the many hazards which the patient had to encounter.

Another operation, practised by Guattani and others, consisted in laying open the sac, removing its contents, and applying graduated compresses to the extremity of the artery at the mouth of the sac. In performing this operation, some surgeons, among whom was Guattani, endeavoured to arrest the hemorrhage by pressure alone, using compresses for this purpose; others, retaining the use of compresses, also applied styptics. After the introduction of the tourniquet by Morel, towards the end of the seventeenth century, the danger from loss of blood during the operation was diminished, as hemorrhage could be prevented until the surgeon had accomplished the immediate object of his operation. Whoever reads the description of their operations, as given by Guattani, Deschamps, Pelletan, and others, will readily admit that few things in the history of surgery are more horrible, and that it is not, therefore, very surprising that many surgeons in those days arrived at the conclusion, that until a safer and more successful mode of operation should be discovered, the most advisable procedure was amputation, which, accordingly, was often resorted to.

Another operation was, however, before long, suggested, namely—the method so successfully practised at the present day, of tying arteries. It seems very surprising that there has been so much difference of opinion as to whether this operation should bear the name of Anel, of Desault, or of Hunter, when, by a careful examination of the then practice, it is so easy to determine the merit which belongs to each of these great men.

To Anel, undoubtedly, the merit belongs of having first introduced the important principle of not interfering with the aneurismal sac, but leaving it entire; he tied the artery above the sac, but as close to it as possible. This method he successfully practised on the brachial artery in 1713; the important point in it is the placing of the ligature on the artery, and not interfering with the tumour.

The treatment which was practised by Anel for an aneurism of the brachial artery, Desault applied to a case of aneurism of the popliteal artery in the Hôtel Dieu, Paris, in the month of June, 1785—the same year in which Hunter performed his first operation. The grand objection to the method practised by Anel and Desault is, that the artery was tied as close as possible to the aneurismal sac; its recommendation

(as has been already observed) is, its principle of not interfering with the tumour.

To John Hunter, undoubtedly, belongs the merit of suggesting the method now so generally adopted, and of establishing its success by experience. In Hunter's method, to which he was led by a consideration of the physiological principles applicable to the cure of this disease, the aneurismal sac is not interfered with, and the artery is tied on the cardiac side of the tumour, at a considerable distance from it, where the artery is easily accessible, and where its coats are more likely to be free from disease, the removal of the aneurism being left to the action of the absorbents. Hunter performed his first operation in St. George's Hospital, London, in December 1785 (a few months after Desault's operation in the Hôtel Dieu, Paris), in a case of popliteal aneurism, for the cure of which he tied the femoral artery; and the desired result was obtained. This mode of operation is justly regarded as one of the greatest improvements in surgery, nor can there be any question that Hunter is entitled to the praise of having first suggested it and proved its success. It has been said "that those who render themselves useful to their fellow-men by their important discoveries in the sciences belong to every country, and, that they deserve praise from one pole to the other; but it seems to us, also, that each nation may, without being taxed with egotism, claim for itself, and attach to its own soil the discoveries or improvements which are its property, and which tend to increase its scientific glory."

As the effects of a ligature properly applied to an artery, and the various changes which result, have already been minutely described in a former section, it seems unnecessary to do more than to refer to that description, and to add, that the immediate object which the surgeon wishes to accomplish is, to set the fluid contents of the sac in some measure at rest, which will be indicated by the arrest of the pulsation and the bruit; and this will be followed by their coagulation, and, consequently, by the entire consolidation of the tumour. Slight contraction of the sac takes place at the moment the force of the blood is arrested by the application of the ligature, and the whole contents of the sac being converted into coagulum, the remaining part of the cure is carried on by the same process as when consolidation takes place in a spontaneous cure. From what has been stated as to the immediate object which the surgeon desires to accomplish, it will be evident, that it must always be a matter of the greatest anxiety that the pulsation be arrested on the application of the ligature; and, as the desired result may be prevented either by the existence of a variety of the arterial system, or by an extremely free communication with the trunk between the ligature and the aneurism by means of anastomosing vessels, the immediate effect produced by the ligature on the pulsation is anxiously observed. It often happens that, although the pulsation is arrested by the application of the ligature, yet in the course of a few hours, or at a later period, on the collateral circulation becoming fully established, it returns in a slight degree. This is, no doubt, occasioned by the blood not being rendered altogether stationary at once, and by some passing into the aneurismal sac from vessels arising above the ligature; but,

although the return of pulsation even in any degree is always a cause of much anxiety to the surgeon, it almost invariably, in such cases, gradually diminishes and ultimately disappears, in consequence of the enfeebled force of the circulation being insufficient to overcome the tendency of the blood to coagulate. The condition which it is desired to produce by the operation is, the solidification of the tumour. For promoting that state, it seems essential that the force of the circulation be enfeebled, and this is accomplished by tying the main trunk, although the blood is not rendered at once perfectly stationary in the aneurismal sac. The tumour is gradually diminished by absorption; and, with regard to the condition of the main trunk, on which the aneurism is situated, it has been found, in some instances, that it has become obliterated from the first branch above the ligature to the first below the aneurism, an example of which is mentioned by Sir Astley Cooper, where the obliteration extended from the origin of the deep femoral artery to the commencement of the tibial arteries.

But such an extent of obliteration is extremely rare; and in most specimens which have been examined and recorded, it has been found, that the trunk has been obliterated in two situations, namely, from the first branch above the ligature to the first branch below it, and for a short distance above and below the aneurism: so that an insulated portion of the artery preserves its cavity between the obstructed parts, and a double collateral circulation connected with the insulated portion, assists in maintaining the circulation through the extremity. By one collateral circulation blood is conveyed from the arterial trunk above the ligature, to the upper part of the insulated portion, and by the other, from the insulated portion to the main trunks on the distal side of the aneurism. At the time when Hunter performed his operation, the proper method of applying a ligature to an artery was not known, and to prevent hemorrhage, various plans were adopted which were calculated to insure the occurrence of the event they were intended to avert. Some of these methods were, the application of ligatures of reserve, tying the ligature very loosely from a dread of dividing too early the arterial coats, the application of pieces of tape for ligatures, and the introduction of soft bodies, such as pieces of cork, between the ligature and the artery. But the experiments and the investigations of Jones having discovered and established the principles which should be the guide in applying a ligature to an artery, the Hunterian operation has, by the application of these principles, been brought to its present state of perfection. The site selected for the operation should not be so near to the aneurism, as to interfere with the artery where its coats are the subject of degeneration, nor so distant from it as to risk the danger of too free a collateral circulation. The ligature should be small, round, and firm; the artery should be exposed as little as possible in front, only so far as to admit the point of the needle into contact with the artery; and laterally and underneath, only by the track of the needle. The ligature should be tied very firmly, so as to divide the inner and middle coats; one end of the ligature should be cut off, and means used to promote union of the wound by the first intention. For some time previous to the operation, as well as afterwards, until the

ligature comes away and the wound is perfectly healed, it is necessary to enjoin the use of the antiphlogistic regimen; and in some cases, where the pulse is very strong, it is advisable before the operation, to have recourse to general depletion for the purpose of diminishing the force of the heart's action. With the same view it is also prudent, in some instances, to bleed after the operation; and when an important vessel in the neck is tied, bleeding is sometimes to be recommended as a prudential measure to diminish the danger of the occurrence of congestion of the lungs. After the operation, the limb should be placed in a convenient position, the part where the vessel is situated being relaxed. The temperature of the limb usually falls a little, but it soon rises, and as the collateral circulation becomes established, it rises above the natural standard. While the temperature is below the natural standard, it is extremely injudicious to interfere in any way except by covering the limb with flannel, or some soft cloth; for reaction speedily comes on without interference; and there can be no doubt that in various instances where gangrene has followed, it has been the result of excessive reaction induced by the application of heat and stimulants during the depression which had been occasioned by the tying of the main trunk, and the consequent stoppage of the supply of blood. Until some time after the ligature has come away, it is necessary to enjoin not only that the body be kept in perfect rest, but also that the patient should guard against any mental emotion, or any circumstance by which the circulation might be accelerated. At no period is this more necessary than at the removal of the ligature. In some few instances, but it is an extremely rare occurrence, the temperature does not rise above the natural standard at any period after the operation; the reason of which is supposed to be, that the collateral circulation had become fully established before the performance of the operation. From what has been stated it will be evident, that only one ligature should be used. The only exception to this rule is, when from any circumstance it happens that at the part where the artery is to be tied, it is injudiciously detached from its surrounding relations; in such a case it is prudent to apply two ligatures, one at each extremity of the detached portion—a practice as ancient as the time of Aëtius,—and to divide the artery between them, or to leave it entire, as may seem advisable in the particular circumstances of the case.

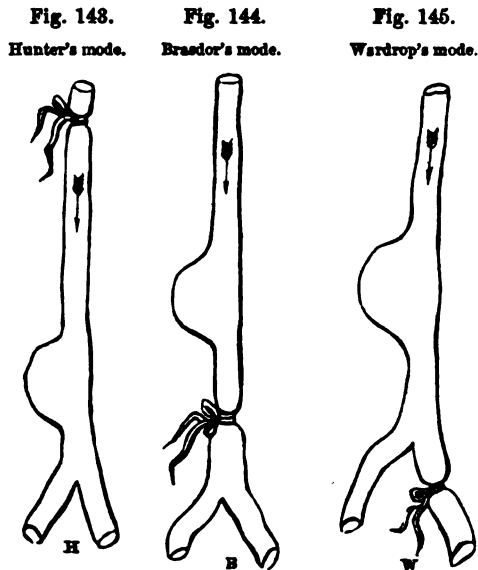
Of late years, however, three operations have been practised; namely, that of Hunter, that of Brasdor, and that of Wardrop.

From what has been stated, the nature and advantages of the *Hunterian operation* are, I trust, evident. It consists, as has been already explained, in tying the aneurismal artery on the cardiac side of the tumour, and at some distance from it.

Brasdor's operation consists in tying the trunk of the artery on the distal side of the aneurism, and in its near proximity.

Wardrop's operation consists in tying one of the two terminating branches of the artery on the distal side of the aneurism.

These different modes of procedure have been illustrated by a diagram similar to the following:—



Brashor suggested that his mode of operation might be applicable to some aneurysms so placed, as to render the Hunterian operation impracticable. Desault also recommended this mode, but neither he nor Brashor performed the operation. Their contemporary, Deschamps, was the first who performed the operation; but it was under very unfavourable circumstances, and without success, in a case of aneurysm as high upon the common femoral as Poupart's ligament. Sir Astley Cooper was the next who practised Brashor's method; it was in a case of aneurysm of the external iliac; the common femoral was tied, but the patient died of the bursting of the tumour some time afterwards. These are the only two instances on record, in which, during a period of more than forty years, Brashor's method was performed, and from their unfavourable results it fell into disrepute. To Wardrop belongs the merit of having first proved the success of Brashor's operation. The subject of the operation was a female, seventy-five years of age, and the case was one of aneurysm of the common carotid artery, where it was impracticable to tie the artery on the cardiac side of the tumour. He tied the carotid on the capillary side, and the result was successful. Wardrop performed this operation in 1825, and it has since been practised by Bush and others, in cases of carotid aneurysm, and the results have proved that although it is a mode of treatment obviously inferior to the Hunterian method, and not generally applicable, yet a surgeon is justified in recommending it for certain aneurysms, situated so near the trunk as to render it impossible to tie the artery on the cardiac side of the tumour. It is obvious that the common carotid presents the most favourable circumstances for the success of Brashor's operation; because, if it

be not absolutely indispensable, there can be no doubt that it is highly desirable that no vessel should originate, either from the sac or between the sac and the ligature. And from this it follows that, as the number of aneurisms in which that condition can be obtained is comparatively few, the utility of the operation is proportionately limited, and moreover the danger of the operation is increased by making it necessary to include the artery in the proximity of the aneurism.

Mr. Wardrop suggested his mode of operation for aneurism, so situated that neither Hunter's method nor Brasdor's can be adopted; as, for example, for the case of the *arteria innominata*; and he was led to do so by considering, that if the circulation in the sac be diminished in force, though it be not completely stopped, this will be sufficient to promote the formation of fibrinous concretion. Mr. Wardrop was the first person to perform this operation in a case in which he tied the subclavian vessel; it has since been performed by Mr. Evans, Dr. Valentine, Mr. Mott, Dr. Morrison of Buenos Ayres, M. Langier, Mr. Fearn, and others; but the statistical results are extremely unfavourable, and there is every reason to fear that in cases treated according to this method, the issue will almost invariably be found unsatisfactory. Certainly this mode of treatment has not gained the favourable opinion of the profession.

TREATMENT OF ANEURISM BY PRESSURE.

Pressure has long been employed in the treatment of aneurism, and is much recommended by many of the earlier writers; but its good effects seem to have been much overrated, for although the records of surgery furnish examples of the cure of aneurisms under the employment of pressure, yet there is reason to believe that until of late years, when this mode of treatment has been revived and employed on more scientific principles than formerly, the cures were in great measure owing to the quietude, abstinence, and depletion which were practised at the same time, and which, even though unaccompanied by pressure, would tend to promote a spontaneous cure. The pressure was applied sometimes to the whole limb, sometimes to the aneurism alone, and sometimes to the denuded artery; but the two methods most frequently adopted were, to apply it to the aneurism and the artery leading to it, or to the artery alone on the cardiac side of the tumour. The former of these two methods was adopted by Guattani, who was one of the greatest advocates for compression in the treatment of aneurism. He used firm compresses over the tumour and the artery leading to it, and applied a roller from the under part of the swelling to the upper part of the limb. He applied the roller anew, and somewhat more tightly every eighteen or twenty days. With this local treatment he combined general blood-letting, rest, and spare diet. With regard to the result of this procedure, Guattani relates that of fourteen cases, four were cured; in one, the treatment was discontinued on account of the pain; in one, after the use of pressure for three years, an operation was deemed advisable; in one, the tumour was diminished, but the result is not stated; and in seven, no benefit was obtained.

Guattani does not seem to have had an idea, that by this treatment

he obliterated the artery and established a new circulation ; but Scarpa conceived that when pressure effected a cure, it was by bringing into contact the opposite parietes of the vessel, and producing obliteration of the cavity of the artery by adhesive inflammation, a process to which the diseased condition of the artery is sadly hostile. In some instances Guattani employed pressure for the purpose of exciting suppuration in the swelling.

Pressure on the artery alone at some distance from the aneurism was the mode of treatment often adopted ; the limb was left free, and the pressure which was employed with the intention of exciting inflammation in the vessel, and rendering it impervious by plastic deposition, was confined to the artery and to the opposite part of the limb.

This method was successfully employed by several of the French surgeons, particularly by Dubois and Dupuytren. Dubois cured several external aneurisms by pressure. In one case of popliteal aneurism, the pressure was applied on the front of the thigh on the 25th of February, and the patient was presented to the faculty of medicine in Paris on the 29th of the next month, completely cured. Other French surgeons tried this method of treatment ; and in this country Sir William Blizard, Sir Astley Cooper, Mr. White, and others ; but the continued pressure necessary to induce obliteration caused such insupportable pain, that it was often found impossible to persevere with the treatment ; and this circumstance, together with the local inflammation, sloughing, and constitutional disturbance, which often resulted, led to the abandonment of it in this country as a means of inducing obliteration of the vessel.

The treatment of aneurism by pressure has lately been revived, but on new and improved principles ; and the new mode of employing it has been attended with so great success, that it may now be said to be completely established. The ultimate object aimed at being the consolidation of the contents of the aneurismal sac, its attainment is sought by weakening the force of the circulation through the aneurism ; and for this purpose pressure is applied to the artery leading to the aneurism at a considerable distance from the tumour, and employed to an extent only to weaken the force of the circulation, and not to produce obliteration of the artery. As this does not require severe pressure, the objections made to the former mode of treatment, that it was impracticable on account of the pain, and that the pressure often gave rise to severe and dangerous local results, cannot be urged against the method which is now employed.

Dr. Bellingham, one of the surgeons of St. Vincent's Hospital, Dublin, has the merit of having suggested this new mode of using pressure, and of having proved its success, and brought the subject before the profession. He has treated a considerable number of cases with perfect success, and his method has been tried with equally gratifying results by other surgeons in Dublin, and elsewhere. Dr. Bellingham is said to have stated in regard to the favourable impression entertained of this mode of treatment, "So highly satisfactory has been the result of compression in Dublin, that no surgeon of that city would in the present day perform the operation of applying a ligature to the femoral artery for popliteal aneurism." Liston, Ousack, Hutton, Porter, Greatrex,

Newcomb, O'Farrell, and others, have treated aneurisms by this new method with perfect success; and it may now be said, that this mode of treatment has received the approval of all leading surgical authorities, with the exception of Professor Syme, whose success in treating aneurism by Hunter's operation has been so remarkable—he having tied the femoral artery twenty times with perfect success for the cure of popliteal aneurism.

In Tuffnell's "Treatise on the Treatment of Aneurism by Pressure," published in 1851, I have seen the following satisfactory report of the results in thirty-nine cases of aneurism which occurred in Dublin during the last eight years:—

"Thirty-nine cases in all.

"In thirty, cure perfect and complete by pressure.

"In one, compression was discontinued, the aneurism not subsequently increasing in size.

"In two, the ligature was resorted to, and the artery tied with success.

"In three, amputation was necessary, each instance being followed by recovery.

"In one, death took place from erysipelas.

"In two, death took place from coexisting disease of the heart."

There are many aneurisms beyond the reach of pressure, and there are others in arteries to which it is not adapted; but such facts cannot reasonably be urged as objections against this mode of treatment in cases to which it is applicable, especially as its employment is not attended with the slightest risk to the patient, and even though it should be unsuccessful, it will retard the progress of the disease, and interpose no obstacle to the subsequent operation by ligature.

When Dr. Bellingham first called attention to this interesting subject, he stated it as his opinion, that it would be unnecessary to employ such a degree of pressure as would cause inflammation and obliteration of the artery at the seat of the pressure; but that it would be sufficient merely to weaken the circulation through the artery and the sac, thereby favouring consolidation by the deposition of lamellated coagulum. In some cases treated successfully by this mode, opportunities have occurred of making post mortem examinations in consequence of the fatal results of other diseases; and it must have been gratifying to Dr. Bellingham to find, that in most of these instances, the main artery was pervious everywhere except at the aneurism. After the Hunterian method, the main trunk is usually impervious at two parts, namely, at the ligature, and at the aneurism, and pervious between them; after treatment by pressure, it becomes closed only at the sac. I am aware of one case treated by Dr. Bellingham's method, in which the artery became impervious from the seat of the pressure to the aneurism, but this condition is not believed to be the most frequent.

Various contrivances have been employed for applying the pressure. It should be constantly maintained and applied at different points, so as not to cause irritation of the skin; and it is therefore desirable to have more pads than one in front of the artery. One appliance which has been used, is an arc of iron, with a pad behind, and two or more in

front, movable by means of screws; one pad should be made to press against the artery, and when it causes discomfort, another should be applied against another point, after which the pressure by the former should be slackened.

The Signoroni Tourniquet has been found a useful apparatus for fulfilling the required conditions; namely, for producing a constant, but very moderate pressure, and for applying it at different points, according as it can be conveniently borne. The pressure may be renewed at the point where it was first applied, when the parts have recovered from the effects of the former application.

FALSE ANEURISM.

The various forms of false aneurism, which are of traumatic origin, and usually result from unskilfulness in the performance of venesection at the bend of the arm are, circumscribed false aneurism, diffused false aneurism, aneurismal varix, and varicose aneurism. Either of the first two varieties, however, may occur in any part of the body, if an artery be wounded; and either of the last two in any part where an artery and a vein in proximity to each other, are both wounded.

Circumscribed and Diffused False Aneurism.—These two varieties differ from each other principally in extent, and this depends mainly on the condition of the surrounding cellular tissue. If, when an artery is wounded, the surrounding cellular tissue or fascia, underneath which the

Fig. 146.



blood escapes from the vessel, be dense or firm, a circumscribed false aneurism may be the result; whereas, if the surrounding tissue be loose and capable of dilatation, the aneurism which forms, will be diffused.

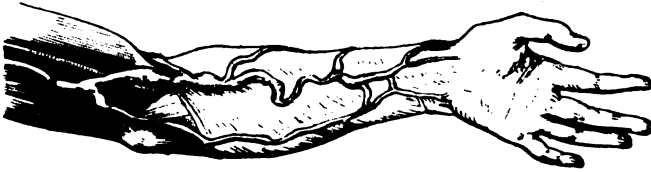
When an artery is wounded, as a grand object of treatment is to prevent the occurrence of aneurism, the energetic employment of pressure is most important; and the best means for this purpose are a graduated compress and a roller; a very necessary precaution, however, is the previous bandaging of the limb, without which energetic pressure cannot be safely employed. If an aneurism be formed, the treatment must depend on the state of the parts. If, in consequence of partial consolidation of the contents of the sac, the aneurism be but partly compressible, either the Hunterian treatment may be adopted, or pressure according to the improved principles on which it is now applied to the treatment of true aneurism; but if the contents of the sac be entirely fluid, the proper treatment for effecting a complete cure consists in tying the artery both above and below the wounded part.

Aneurismal Varix.—When, in consequence of a wound, a direct

Fig. 146. From Liston.

communication is made between an arterial and a venous trunk, a disease may be formed which was first described by Dr. Wm. Hunter, in the year 1756, and for which, at a subsequent period, Dr. Cleghorn, of Dublin,

Fig. 147.



suggested the name of aneurismal varix. This disease may occur in any part of the body where an artery and a vein, in proximity to each other, are both wounded; but it most frequently presents itself at the bend of the arm, and results from the transfixing of the median basilic vein, and the wounding of the artery in the operation of venesection. Thus three wounds are made before the disease takes place; one on each side of the vein, and one in the artery. The wound in the dermoid, or superficial side of the vein may heal, but that on the opposite

side of the vein, and that in the artery may remain open, and through these openings a communication may be established between the two vessels. The effects of this communication and direct ingress of the arterial blood into the venous trunk are, that the implicated vein suffers cylindrical widening, and becomes infected with sac-like dilatations; the artery, on the distal side of the disease, becomes generally smaller, and its coats thinner, in consequence, no doubt, of the diminished quantity of blood received into it; and on the cardiac side of the wound, the artery is usually widened, sometimes to a great extent, if the disease be of considerable standing. This last-mentioned condition, namely, the widened state of the artery on the cardiac side of the wound, is one which has attracted the attention of various authorities; and before a surgeon ventures to recommend an operation, he must be well satisfied that it does not exist, or only in a very slight degree; because in the event of the artery being very much widened, its inner surfaces cannot be placed closely and uniformly in

Fig. 148.



Fig. 147. From Liston.

Fig. 148. Aneurismal varix, following wound of femoral artery and vein, the former being enlarged to the size of a portion of small intestine. From a preparation in my museum.

apposition ; but the walls of the vessel will be puckered up by the ligature, and when the ligature is removed, hemorrhage will, in all probability, result. If the artery be considerably widened, the pulsation will be felt over a broader surface than usual. The accompanying delineation is taken from a beautiful example of this condition in a preparation in my own collection. The superficial femoral vein and artery were wounded, aneurismal varix was the result, and the vessels were enlarged as here represented.

The symptoms of aneurismal varix are, feeble pulsation of the artery on the distal side, and a swelled and tortuous condition of the vein, in which a peculiar thrill and bruit are very perceptible. The bruit has been compared by some to the purring of a cat, by some to the prolonged articulation of the letter R, by some to the noise of the fly-wheel of a music-box, and by others to the buzzing of a fly confined in a paper bag. The limb beyond the seat of the disease is usually cedematous and cold, and the skin often presents a cyanotic hue in consequence of the pressure causing congestion, and obstructing the free return of the blood.

With regard to treatment, as this affection is in most cases merely a source of inconvenience, and becomes stationary, palliative treatment, consisting of pressure applied over the whole limb, and more powerfully over the disease, in all that in such circumstances is deemed advisable; but if the symptoms be so urgent as to demand an attempt to accomplish a radical cure, the proper mode of procedure is, by cautious dissection, to expose the artery, and to tie it above and below the opening: this course, however, cannot prudently be adopted, if the artery be widened as above described. From what has been stated it will be evident that it is at an early period that an operation is most likely to be useful.

Varicose Aneurism.—The difference between this affection and aneurismal varix is, that in this the communication between the wounded artery and the vein is not direct, but through the intervention of an aneurismal sac. The blood having escaped through the wound in the

Fig. 149



artery passes into the surrounding cellular tissue, which it distends into a sac, and from this sac it is discharged into the vein. The swelling in this instance is formed partly by a circumscribed tumour, and partly by the dilated vein; the former usually continues to increase, as the blood is thrown out more rapidly from the artery than it is transmitted into the vein. The treatment in such cases consists in deligation of the artery both above and below the wounded part. The first case of this

Fig. 149. From Liston.

disease which we find in the records of surgery in this island, is one which occurred in the experience of Mr. Park, in the Liverpool Hospital. On opening the dilated vein, an orifice was found in its posterior part, communicating with a sac, which sac on being examined presented an orifice leading into the artery. Since this case was recorded, many examples have been met with, and they have generally been at the bend of the arm, resulting from unskilfulness or carelessness in the performance of venesection.

DISEASES OF VEINS.

PHLEBITIS.

This term was first applied by M. Breschet, to denote inflammation in the venous tissue, an affection of which veins are very susceptible. Plebitis may be either traumatic or spontaneous, and may exhibit the characters of fibrinous, of limited suppurative, or of diffuse suppurative phlebitis.

FIBRINOUS PHLEBITIS.

Symptoms.—Fibrinous phlebitis—the adhesive phlebitis of Cruveilhier—is the mildest form of this affection, and is characterized by pain, by swelling of the limb below the affected part, by oedema of the surrounding cellular tissue, sometimes, although not invariably, by more or less sympathetic fever of the inflammatory type, and, if the affected vein be superficially situated, by linear hardness and redness in the course of the inflamed vessel. The pain is increased by the dependent posture, by stretching the vessel, and by pressing on the affected part, or on the trunk of the vein leading from it. If the inflammation be slight, there may be little or no swelling or oedema of the limb, or any symptomatic fever. When the affected vein is superficial, the hardness in its course is very distinct; and so is the linear redness, unless the disease be combined with erysipelas, in which case the redness may not be discernible.

State of the Parts.—The local changes resulting from this variety of the disease consist, in the formation of certain unusual conditions of the contents of the vein, and an alteration of the state of its coats and of the surrounding cellular tissue. There is consolidation of the contents of the vein, whereby its calibre is obstructed; the coagulum is formed partly by an inflammatory product which exudes from the coats of the vein, and partly by coagulation of the blood. Gendrin found, that after insulating a portion of a vein by securing it between two ligatures, and after emptying it of its blood, and exciting inflammation by an irritant injection, a plastic substance filling up the whole calibre of the vessel was formed; hence it seems warrantable to conclude, that in this disease coagulum is partly formed by an exudation from the coats of the vein. In some instances, the plug is evidently formed of concentric layers, and in many, the centre of the coagulum consists of dark coagulated blood. At first the coagulum is but loosely attached to the interior of the vessel, but subsequently it becomes more strongly adherent. The coats become red and thick, by plastic effusion into them.

The surrounding cellular tissue becomes the subject of serous infiltration, and that in immediate connexion with the vein is often affected with plastic exudation, by which means the vein and the surrounding textures become firmly adherent to each other; and in consequence of this and of the thickened state of the coats, it has been found in some examples, where there has been an opportunity of withdrawing the plug, that the vein had not collapsed, but that its calibre remained open, like that of an artery. Lymph may thus be thrown out around the vein, and so lead to its firm agglutination to surrounding parts; or into the coats, where it will occasion the thickening of the walls of the vein; or into its canal, producing, if it be to a small extent, a coating along the interior of the vein, or if in greater quantity, leading to its entire obstruction. The vein may be ultimately converted into an impervious cord, or absorption may take place, and its natural condition be restored. While the circulation is interrupted though the inflamed vein, it is kept up by the collateral branches which are in a state of unnatural dilatation.

Treatment.—Low diet, the use of aperient and diaphoretic medicines—the free, and, if necessary, the repeated application of leeches, the preservation of the part at perfect rest, and in an attitude favourable for promoting the return of venous blood, and for relaxing the inflamed vein, the employment of warm cataplasms, or of evaporating lotions, or of the local vapour bath, whichever may be most agreeable to the feelings of the patient, constitute the chief parts of the treatment.

LIMITED SUPPURATIVE PHLEBITIS.

The constitutional symptoms are of the same character as in the former affection, being those of sympathetic fever of the inflammatory type; they are, however, more severe.

The local symptoms at first differ from those of fibrinous phlebitis only in being more intense; but afterwards, in one or two situations, a circumscribed swelling is formed, in which fluctuation and the other characters of a small abscess may be detected. Along with the purulent matter there also exists a coagulum both above and below, by which a barrier is presented to the admission of the pus into the general circulation, and the character of limitation, so essential for the safety of the patient, is thus maintained. The purulent matter is, in some instances, though very rarely, found loose in the vein; it is usually enveloped in a thin fibrinous layer, and sometimes is actually enclosed in the centre of the clot. To determine the mode in which pus is formed within inflamed veins, is a matter of great difficulty, and different views are entertained on the subject. The opinions of some authorities respecting it are so distinctly expressed in an admirable article on Phlebitis, in Dr. Hassie's *Anatomical Description of the Diseases of the Organs of Circulation and Respiration*, that I cannot forbear transcribing the following passages. "The principal question is, whether the pus formed in the veins be the result of secretion from the inflamed surfaces, or of direct metamorphosis of the blood itself. Gendrin believed that he had observed, by the help of the microscope, a direct change of the blood-globules into pus-globules, and he endeavoured to

prove this by the following experiment; having, by means of a double ligature, isolated a portion of an artery or of a vein, he caused it to inflame by injecting an irritant fluid. He then readmitted the current of blood, and afterwards confined it by definitely drawing the ligatures together again. Hereupon suppuration commenced in the vessel, and the blood becoming first coagulated and then deprived of its colour, was by degrees altogether converted into pus. This is the experiment so frequently cited, and by many held to afford incontestable evidence. More recently, M. Donné has employed the microscope for the purpose of demonstrating the conversion of the blood into pus. Having mingled the two substances in the proportion of eight to one, he traced all the gradual changes wrought in the blood-corpuscles, until after the lapse of twenty-four hours none but pus-globules were discernible. On the other hand, Gluge (as formerly Vogel in opposition to Gendrin), has shown that in water and in every other kind of liquid capable of dissolving their capsules, the blood-corpuscles undergo precisely the same modifications of form as those described by Donné. Hence it may be reasonably inferred that the blood-corpuscles become destroyed, and that ultimately pus-globules alone are to be met with in the fluid, serving for the experiment, not that the individual blood-corpuscles are transformed into pus-globules. Gluge could not detect any alteration in the blood, in consequence of inflammation, beyond the formation of what, both by himself and by Valentin, were termed 'composite inflammation-and-exudation-globules.' It would make a material difference could it be shown that the liquid, resulting from the solution of the blood-corpuscles was, at least partially, capable of conversion into organic elementary cells, which, in consequence of the existing inflammation, assumed the form of pus-globules. This view is, however, merely hypothetical, for I have not as yet been able to subject it to the test of experiment. Some light may perhaps be thrown upon the point at issue, by the further prosecution of E. H. Weber's interesting inquiries concerning the minute globules that slowly revolve along the parietes of the vessels, and which, according to that excellent observer, are blood-corpuscles modified through the progress of nutrition. The assumption that the pus is secreted by the coats of the veins is founded upon analogy. Vogel demonstrated the transition of epithelium-cells into pus-globules, and the fact has since been amply confirmed by Henle, who, availing himself of the discovery of Schwann, "that all organic bodies are developed out of nucleated cells," showed, partly by direct observation, partly by analogical reasoning, that out of these 'primary cells' forms may spring, either normal or pathological, as the case may be. Thus pus-globules would originate as the product of inflammation. In accordance with these views, the puriform masses generated within the veins, would be developed as follows. First of all, the epithelium lining, discovered by Henle, separates from the internal membrane of the vein, so as to give to the inner surface of the vessel the dull appearance already described, and to render it more susceptible of a morbid tinge from imbibition. The next change affects the passing blood-corpuscles, which assume a spheroid, or else a gibbous appearance, advance with a slow revolving motion or cling to one

another, parting with their serum (plasma according to Schaltz), and with their pigment. The internal membrane of the vessel generates new imperfect epithelium cells, which mingle with the altered blood, and finally actual pus-globules, which, when congregated in sufficient number, completely arrest the current of the blood, and affect the blood-corpuscles in the manner already pointed out. The simultaneous effusion of both fibrin and albumen now serves to complete the formation of a plug, which differs in external character, according to its more or less rapid development, and to the varying proportions of its constituent parts. The plug thus originating, afterwards undergoes farther changes. It ought not, however, to be concealed that this description rests, for the most part, upon analogy only; the test of microscopic observation having, as yet, demonstrated the above process only in the smallest vessels, and by no means in the larger ones."

The treatment consists in the use of general and local antiphlogistic remedies to an extent proportioned to the severity of the symptoms and the particular circumstances of the case. The whole body should be kept at perfect rest, the affected part being preserved in an attitude favourable for relaxing the inflamed vessel, and promoting the return of venous blood; and warm applications should be diligently employed. When abscess forms, early and free opening should be made, followed by the usual treatment for abscess.

DIFFUSE SUPPURATIVE PHLEBITIS.

Symptoms.—This very dangerous form of the disease sometimes supervenes on the last-mentioned variety, the barrier to the admission of the pus into the circulation giving way in consequence of an increase of the circulation, or of some other cause. In such instances a change is perceptible, both in the local and constitutional symptoms. The local circumscribed swelling subsides, and the constitutional symptoms change very speedily from the inflammatory to the worst form of the typhoid type, the change being often preceded by shiverings. In many instances the characters of the diffuse form are presented from the very commencement of the attack. The local signs in such cases are, pain of a peculiar, oppressive, sickening kind, increased by pressure on the affected vessel, or on its trunk on the cardiac side, by the dependent posture, and by extending the inflamed part; redness, if the affected vessel be superficially situated; diffuse swelling; and cedema. There is great tenderness to the touch along the course of the inflamed vein; but from the absence, both of the plastic effusion and of the coagulum of blood, so essential in suppurative phlebitis for the safety of the patient, there is neither the linear induration, nor the symptom of a knotted cord along the track of the vein. Should death not take place very speedily, gangrene may ensue. The accompanying fever, especially in a more advanced stage, is of a low or typhoid kind, characterized by great prostration of strength, anxiety, irritability, and restlessness, a sense of weight at the præcordia, a very rapid and feeble pulse, paroxysms of oppressed and hurried breathing, black sordes on the tongue and teeth, frequent nausea and vomiting, especially of bilious matter, the countenance sunk and expressive of anxiety and

great suffering, a yellowish or sallow appearance of the body, and before death muttering delirium. Such are the symptoms of this most dangerous disease; and they are believed to depend on the contamination of the blood by direct purulent admixture, pus or a puriform fluid being formed very early, and meeting with no obstacle to its mingling with the blood.

Dr. Arnott, in an interesting article in the fifteenth volume of the "Medico-Chirurgical Transactions," gives the particulars of many fatal cases, and his own conclusions from them. His observations led him to conclude, that there are great differences as to the extent of the vein occupied by inflammation in fatal cases; that in the great majority of cases pus is found within the veins; that there is a striking resemblance between this form of phlebitis and diseases arising from the inoculation of morbid poison, and that death does not take place from extension of the inflammation to the heart, such extension being a very rare occurrence indeed, as the inflammation usually terminates abruptly where a cross current flows into the main trunk through a collateral branch; but that the entrance of pus, or of some other product of inflammation, is the source of the fatal symptoms.

Morbid Changes.—As has been already stated, purulent matter is usually found within the vein; which matter not being circumscribed, as in the limited form, finds no barrier to its admission into the circulation; "the fibrinous dykes" (to use the expression of an excellent writer on surgery) being wanting. There are three situations which the pus may occupy, namely—the interior of the vein, the cellular membrane connecting the coats with each other, and the surrounding cellular tissue; which is often infiltrated to a great extent.

There are many important sequelæ which present themselves in various parts of the body remote from the seat of the phlebitis—but they are all thought to be divisible into two grand classes, the first comprehending such as are referable to the coagulation of the blood in the large venous or arterial trunks, in the central parts of the vascular system, or even in the heart itself; and the second, certain lesions which have their seat in the capillary system.

The coagulation of blood consequent on phlebitis has been met with most frequently in the pulmonary artery. An author, on this subject says:—"It would appear that in such cases, the product of inflammation, be it pus or finely-divided fibrin, follows the course of the blood towards the heart, but advancing more slowly than the uncontaminated blood, accumulates, invests itself again and again with fresh layers of coagulum, and ends by entirely closing up the calibre of individual vascular trunks."

The sequelæ which have their seat in the capillary system, consist of lesions which have been designated by the appellations "lobular inflammations," and "lobular abscesses." These secondary infiltrations are most commonly found in the lungs and liver, especially in the former; they usually present themselves in the form of deposits disseminated through the parenchyma of those viscera, and differ from abscesses in being neither encysted, nor concentrated into one place. In the chest the lungs are the organs most frequently affected, but sero-purulent

effusions are also met with in the pleuræ, the pericardium, and even on the surface of the heart itself. In the abdomen, the liver is most frequently the seat of such deposits; in the spleen, and in the kidneys, they are very rarely found. The cellular tissue, both subcutaneous and inter-muscular, is very liable to become the seat of purulent deposits, the matter being deposited sometimes as in abscess, and sometimes by infiltration. Such deposits are most common in the cellular tissue around joints. Purulent effusions into the synovial membranes of joints, and even destruction of their cartilages, are well known to practical observers as frequent lesions. Phlebitis is also sometimes attended by inflammation of the membranes of the brain and effusions under them, and even by effusions into the ventricles; but deposits into the substance of the brain, as sequelæ of phlebitis, are extremely rare results. In various instances the eye has been rapidly destroyed; the cornea becoming swollen, and eventually bursting, or becoming totally disorganized. Veins, also, quite remote from those originally diseased, seem liable to secondary suppuration. In regard to these lesions, Professor Hassie thus expresses himself:—"Another question still presents itself, namely—whether the pus formed within veins at the part originally inflamed be substantively transmitted through the medium of the circulating current to the lungs, the liver, &c., to accumulate at certain points within the latter; or whether it be actually generated in the parenchyma of those organs. The former opinion was at one time zealously maintained, and numerous observations were adduced in evidence of such metastasis. More recently, however, the latter view has prevailed; and, although in these processes there is still much that remains to be cleared up, yet an unbiassed comparison of the facts has furnished an explanation adequate to the majority of cases. With regard to lobular abscesses, there cannot, at the present day, be any further question of the pus being conveyed to them, *exclusively* and *in quantity*, by the circulation. The best authorities have repeatedly asserted that these collections are not at once purulent at the outset, but knots form, of from the bigness of a pea to that of a walnut, become infiltrated with firm coagulated blood, and eventually suppurate. I have had opportunities of convincing myself of the correctness of this fact with reference to the lungs, the liver, and the spleen. It may be, therefore, concluded that owing to some obstacle, the blood stagnates at certain points, producing suppurative inflammation of the surrounding tissues.

"The experiments of Leuret, Trousseau, and others, and of Cruveilhier, afford an insight into the cause of such stagnation; for when putrid and other substances are injected into veins, organic changes perfectly analogous to those above described, are developed with the accompaniment of low typhoid fever. The experiments of Günther are the most striking of all in their results. Having injected pus into the veins of horses, he very shortly afterwards found fully-formed lobular abscesses in the lungs. From these data we may, with some degree of certainty, infer that pus is conveyed in substance by the veins to the heart, and forwarded from thence; but that those pus-globules, which have reached the capillaries of the lungs in their entire state, are unable, from their size, to permeate the latter. These globules now become a central point of stag-

nation (and, finally, of extravasation) in the adjunct branches of the pulmonary artery, and thus determine, eventually, local inflammation and suppuration.

"In this manner phlebitic abscesses in the *lungs* are satisfactorily accounted for, as are also those which occur in the *liver*, in consequence of inflammation within the tract of the *portal system*. The origin, however, of purulent collections in other organs still remains obscure. Here, indeed, the above explanation is inapplicable, founded, as it is, upon the inability of the pus-globules to permeate the minute capillary vessels of the lungs. Günther found that these deposits were formed *subsequently* to those in the lungs, and believed that they originated from pus being taken up from the diseased parts of the lungs by the pulmonary veins, and thus carried into the greater circulation. Were this explanation correct, phlebitic abscesses must, necessarily, exist in the lungs, wherever such deposits are found in the capillary system of the greater circulation. To ascertain this, I have compared a large number of cases, observed partly by Balling, Dance, Arnott, and others; partly by myself. Amongst them, however, there are only two (one related by Sasse, of purulent deposits in the liver, and one by Dance, of purulent exudation within the wrist-joint), in which the non-existence of pulmonary abscesses is established by careful examination after death. Four of Arnott's cases—the first, third, seventh, and ninth—would certainly appear to belong to the same class; they are, however, not related sufficiently in detail to admit of any decided inference being drawn. It is singular, indeed, that the seat of the purulent secretion, in those four instances, was within serous sacs—in three of them, within those of different articulations, and in one, within that of the pleura. It may, upon the whole, therefore, be assumed that in some cases the substances commingling with the blood, pass through the capillary system of the lungs, without inducing any changes in the pulmonary parenchyma. Vogel, without, indeed, assigning any reason, considers it not impossible for single pus-globules to pass through the capillaries of the lungs; it is perfectly intelligible, at all events, that the nuclei of ruptured pus-globules may pursue their course, without hindrance, into the greater circulation. This applies equally to fibrin altered by the inflammatory process, finely-divided particles of which will, if hurried along by the circulating current, be, in many cases, productive of the same effects as pus."

Causes.—Phlebitis seldom originates spontaneously, and can, in most instances, be traced to some injury done to the vessel itself, or to the communication of inflammatory action from some contiguous textures.

Injuries affecting bones, as has been particularly pointed out by Cruveilhier and others, often give rise to venous inflammation. A blow, pressure, extension of inflammation from ulcers, cold, suppuration in the shaft of a bone after amputation, are all causes of phlebitis. It is well known that in the Hôtel Dieu of Paris, lobular pneumonia, induced by phlebitis, was at one time a frequent cause of death among patients on whom operations had been performed. Other ordinary causes of inflammation of veins, are wounds of veins by accident, or in venesection, or other operations in which veins have been wounded or tied; and hence

arises the necessity of avoiding, as much as possible, any interference with veins, and especially of not including them in ligatures, except under the most urgent circumstances. Many fatal examples have resulted from venesection, owing mostly to the use of a dirty lancet in bleeding, or to too free an exercise of the limb before the wound has properly healed; or to an irritable or unhealthy state of constitution, which not only predisposes most strongly to an attack on the application of an exciting cause, but modifies, in a great degree, the character of the inflammation.

Symptoms.—While the symptoms are of the sthenic type, the local and constitutional treatment formerly recommended should be adopted; but when typhoid symptoms appear, or when the constitutional affection is, from the commencement, of the asthenic character, while the same local treatment, more or less modified according to circumstances, is proper, the object aimed at by constitutional treatment should be, to support the strength and to allay as much as possible the irritative fever; for which purpose the means generally employed are, diffusible stimulants, wine, light nourishment, and the use of calomel and opium, or calomel in combination with some of the preparations of morphia. No treatment, however, as yet suggested, is found to have much effect in arresting the progress of the disease, and, consequently, the prognosis in this form of phlebitis is extremely unfavourable.

VARICOSE VEINS.

CAUSES, ANATOMICAL CHARACTERS, AND TREATMENT.

Varix, which has been defined to mean, “a vein preternaturally dilated without the dilatation being instituted to answer any good purpose in the animal economy,” may originate in any permanent obstruction to the venous return, as for instance, in pressure on the venous trunks above, induced by distended rectum, by diseased liver, by the gravid uterus, by aneurismal or other tumours; or it may arise from some obstacle to the passage of the blood through the heart or lungs, or from relaxation or weakness of the coats themselves. According to some authorities it arises more frequently from weakness of the veins than from any other cause. In some examples, obstruction from inflammation in the vein itself has been supposed to give rise to the disease; and, in some, violent and sudden muscular exertion has occasioned it.

Varices occur principally in three situations, namely, in the lower extremities, in the spermatic cord, when the disease is termed varicocele; and about the lower part of the rectum, constituting the disease called hemorrhoids, or piles. Varicose veins occur occasionally in other parts of the body, various examples of which are recorded, and in most of them the disease could be clearly traced to some obstruction to the return of the blood by the venous trunks leading from the affected part. It is to varices in the lower extremity that the following observations are intended to apply. It is an extremely rare thing for the deep-seated veins to be the subjects of this disease, in consequence of their coats being supported by surrounding textures. The vessels which afford examples are the vena saphena interna, and the vena saphena externa; but principally the former, the branches of which about the

ankle and inner part of the leg are often affected. These veins are so situated that their coats receive little support from surrounding structures to aid them in resisting the dilatation caused by accumulation of blood within them.

The calibre of a vein affected with this disease is enlarged. The vessel is not only dilated, the dilatation either being nearly equable, or presenting sacculated or knotty protuberances on various parts, but it is also elongated, and thereby becomes tortuous. In many instances the vein exhibits a very irregular aspect, being equably wide at some parts, comparatively narrow at others, and at others dilated into irregularly shaped cavities. The enlargement may be accompanied either by increased or diminished thickness of the coats, or by both states at different points. The state of the coats, however, is not the same in the different forms of varix, nor in the same form at different periods. Professor Hassie of Zurich, makes the following observations on this subject. "In persons affected with a morbid preponderance of the venous system, we first of all observe an undue prominence of the veins of the skin. These appear in dense nets of branches, remarkable for their diffuse distribution, and are generally turgid with blood, or liable to become so from the slightest mechanical or dynamical causes—like what, under ordinary circumstances, would be the effect of violent and prolonged muscular exertion. In this condition of the veins their coats have not undergone any absolute change, being everywhere proportionate to the width of the calibre; the vessels are not more than usually tortuous, and cannot as yet be called morbidly altered; after a while, however, the veins become permanently dilated, an occurrence more frequent in elderly than in young persons. This is brought about by a reinforcement of the fibrous texture of their external coat, in the shape of an accession of conspicuous transverse fibres. Meanwhile the internal membrane remains unchanged in structure, merely displaying numerous lines of superficial furrows running lengthwise, and the vessel still maintains its natural course, not assuming a more sinuous, but rather, if anything, a straighter direction than before. It does not collapse when cut through, but remains patent, and is distinguishable from the arteries by its colour, which is of the same pale red as the fibro-felt-like texture constituting the normal external membrane of a vein. The valves remain unaltered. In this condition the saphena is frequently found in old persons; so likewise are certain branches of the vesical plexus, whilst other branches manifest still farther changes. In the greater number of instances, however, the external membrane of the vein is not thickened, but, along with the other membrane, undergoes considerable attenuation, in proportion as the vein becomes more and more dilated. Conformably with their irregular disposition, the intermediate fibres give way unequally, allowing the internal membrane to jut out in sac-like protrusions, and to establish so many irregular, constricted, pear-shaped, and often in appearance, pediculated tumours. At the commencement of some of the smaller branches the membrane thus forms pouch-like dilatations, or forces itself between the longitudinal fibres of the external membrane in lengthy protuberances, which exceed in circumference that of the vein in its natural state; or, it may,

perhaps, distend cylindrically and pretty equably for a considerable length the intermediate fibres before alluded to. Meanwhile the valves become attenuated, and pulled asunder transversely, so as to be rendered useless; in many instances they become partially or wholly obliterated, and are torn into shreds, or destroyed as far as their free border, which then runs across the diameter of the vessel like a filament or band, attached by the two extremities to the internal membrane. The veins now appear elongated, and their course very tortuous."

Professor Andral has described six different forms of enlargement of veins which he has met with in dissection, but many pathologists question the propriety of classing some of them with varices. They are the following:—

1. Simple dilatation without any other change.
2. Equable dilatation with attenuation of the coats at the affected part.
3. General dilatation, and a tortuous condition, with thickening of the coats.
4. Partial dilatation, with thickening of the coats.
5. Dilatation, with septa within the veins. These septa, as will be understood from what is stated above, are not now regarded as of new formation.
6. Dilatation, with septa and perforations in the coats, by which perforations the cavities of the veins and the surrounding cellular tissue which is diseased, communicate. The kind of disease of the cellular tissue will be considered under the head of the anatomical characters of hemorrhoids.

Varicose veins at first contain blood in a fluid state; but an alteration of the contents, which frequently occurs, is the coagulation of the blood, whereby the vessels become obstructed. The formation of coagula is considered to be a product of inflammation, varicose veins being liable to be attacked by that process, and, as was stated in the description of the anatomical characters of some of the forms of phlebitis, coagulation of the blood is an early result of inflammation when it attacks the venous tissues.

In many instances varicose veins create little inconvenience; in others they cause much discomfort and annoyance by pain, fulness, and weakness of the affected part, aggravated by exercise and the erect posture; but the following results are not unfrequent—phlebitis, hemorrhage, certain conditions of cellular tissue, varicose ulcers, and inflammation of the skin.

Inflammation of the vein may be of a low grade, giving rise to coagulation of its contents; or it may affect both vein and cellular tissue, and, reaching the suppurative grade, give rise to small abscess in the first instance, and afterwards to varicose ulcer, although this is not, as will hereafter be stated, the mode in which the form of ulcer denominated varicose usually originates. Phlebitis, when a consequence of varicose veins, usually assumes the form of fibrinous phlebitis, producing destruction, or of limited suppurative phlebitis, but very rarely indeed that of the diffuse suppurative variety. In some instances, the vein and superficial parts have become so greatly attenuated as to produce bursting of

the vessel, followed by serious, and occasionally even by fatal hemorrhage. The valves being rendered incapable of performing their office, the pressure of the column of blood may give rise either to inflammation, or to increase of dilatation, and eventually to hemorrhage, which, as there is no obstacle to the descent of the blood from the trunks of the veins, may be excessive.

Other conditions of frequent occurrence are, œdema of the cellular tissue, merely from obstruction of circulation; or œdematous effusion, as a product of a low grade of inflammation of the cellular tissue, when the substance effused is of a less fluid character than when the œdema arises from the obstruction to free circulation; or, if the inflammation be of a rather higher grade, the cellular tissue may be consolidated by effusion of lymph. Such are the more frequent conditions of the cellular tissue surrounding varices in general; but in that variety which constitutes a form of hemorrhoids, a different state of cellular tissue is found, as will be stated in another section.

Varicose ulcers are frequent consequences of varices, and they arise either from limited suppurative phlebitis ending in abscess, and the formation of an ulcer, or from inflammation of the skin, which either cracks or has a scab formed over an irritated and inflamed part, where an ulcer ultimately forms.

Treatment.—The treatment of varicose veins is either *palliative* or *radical*: the former has now almost entirely superseded the latter, and in the opinion of the writer ought always to be preferred, except when the disease endangers the life of the patient.

Palliative Treatment.—One of the most important indications, except in the case of pregnancy, is to remove, if possible, the exciting cause; and for that purpose remedies adapted to the particular circumstances of the case ought to be prescribed. In all cases it is advisable to preserve the bowels in a regular state—to enjoin the use of light nourishment, but with abstinence from liquids—to direct the patient not to remain long in the erect posture—to remove from time to time from the weakened vessels the weight of the superincumbent column of blood—to recommend that the recumbent posture be frequently assumed in order to favour the return of blood, and that violent or long-continued muscular exertion be avoided; and, except in the case of phlebitis, to support the weakened vessels by means of pressure. For this last purpose, a common roller, or a starched bandage, or elastic bandages of India-rubber, are sometimes used; but the two most convenient appliances, as affording a very equal pressure, are an elastic stocking, or an elastic bandage of stocking web. The pressure should be sufficient to afford support, and to diminish the size of the dilated veins, but not to produce any undue constriction of the limb.

If the varicose veins be affected with phlebitis, pressure will be extremely injurious. In such cases the treatment consists, in preserving the whole body at perfect rest,—keeping the affected limb in the horizontal posture,—applying leeches in the neighbourhood of the vein,—employing either cold lotions or warm applications, as may be most grateful to the feelings of the patient; together with the strict observance of antiphlogistic regimen.

Radical Treatment.—It would answer no useful purpose to explain all the methods which have been adopted for effecting a radical cure. Among them the following deserve to be noticed :—

1. Puncturing the vein, a plan proposed by Hippocrates, evacuating its contents, and stopping the hemorrhage by means of pressure.

2. Excision, originally proposed by Celsus, checking the hemorrhage either by tying the trunk at each extremity of the cut portion, or restraining it by pressure.

3. Tying the vein, a proceeding anciently proposed by Aetius and Paulus Ægineta, has been revived and strongly recommended by Sir Everard Home, and adopted (with differences in the mode of tying) by Ricord, Taignot, and some others. For the cure of varicose veins of the leg, Sir Everard Home tied the saphena interna by dividing the skin over it, and passing a needle armed with a ligature under the vein. The object of his operation was, to produce obstruction of the principal trunk leading from the varix. In some cases it was believed that benefit was derived; but several cases having proved fatal, these unfavourable results put a stop to so hazardous and unjustifiable a practice, which for the removal of an inconvenience, placed a patient's life in the greatest danger. As obstruction of circulation through a venous trunk is often the cause of varix, it is difficult to understand on what principle the operation of Sir Everard Home can prove useful, except where the venous trunk itself has become so greatly distended that its valves are unable to prevent the weight of the column of blood in the venous trunk from pressing on its branches. Some surgeons think it useful by promoting collateral circulation, so that the blood is returned by different channels. Sir Benjamin Brodie, in stating objections to this operation, remarks, "But still there is another reason against having recourse to this operation. I do not believe, from what I have formerly seen, that it permanently benefits the patients. It is true that they appeared to go out of the hospital much relieved; but where I had the opportunity of seeing them one or two years afterwards, I always found them as bad as ever. Indeed, I am by no means certain that the benefit which the patients seemed to derive, in the first instance, was the result of the operation; and I am more inclined to believe that it arose from their having been necessarily kept for some time in bed in the horizontal posture."

4. Cutting through the vein. Various modes of this operation have been adopted; but of all with which I am acquainted, the safest appears to me to be that proposed and practised by Sir Benjamin Brodie, who used a narrow sharp-pointed bistoury with the edge on the convex side, and when his object was to cure a cluster of varicose veins, he introduced the instrument through the skin, carried it flat between the skin and the veins, and then directed the edge against the veins, and in withdrawing the instrument cut across the veins, leaving but a very small wound in the skin; the hemorrhage he arrested by the pressure of a compress. He was induced to try this operation from observing that, although operations on large veins are apt to lead to dangerous results, there is no reason to fear danger from operations on the smaller branches. In reference to this mode of subcutaneous division of varicose

veins, Sir Benjamin Brodie observes, "As applied to varicose veins, the operation is as easy and as safe as it is on other occasions; yet I scarcely ever have recourse to it now. With my present experience it really appears to me that in ordinary cases it is not worth the patient's while to submit to it, as I always observed that, if I cured one cluster, two smaller ones appeared, one on each side, and that ultimately I left the patient no better than I found him. The operation, however, is proper, where there is a varicose cluster much distended, and liable to burst and bleed. Here you may actually save the patient's life by having recourse to it; and you may do so without considering whether fresh clusters are or are not likely to form afterwards."

5. Pressure by means of a needle and twisted suture in order to effect obliteration of the vein has been practised with considerable success by M. Velpeau. He introduces a needle underneath the vein, and applies a twisted suture round its ends, and if considerable inflammation supervenes, he withdraws it in a few days, his object being to induce sufficient inflammation to reach the fibrinous grade, and thereby to cause occlusion; but if little inflammation result, he allows the needle to eat its way through. Few serious consequences appear to have resulted from this operation; and it is therefore regarded less unfavourably than various other modes for attempting obliteration of varicose veins.

6. *Cauterization*.—The potassa fusa has been applied to different situations, and in different forms, according to the different immediate results through which it is hoped to effect the cure. One method is, to apply the potassa fusa over the venous trunk, and to employ it so freely as to produce a slough of the vein together with that of the surrounding parts. The change desired in this method is the permanent obstruction of the canal of the vein by the destruction of a part of the trunk and fibrinous inflammation in the parts surrounding the slough. Pressure is applied to the dilated veins; and when this method proves beneficial, it is believed that this result arises from the blood being forced to return by collateral circulation, by which means the distended vessels become unloaded, and are placed in circumstances more favourable for recovering tone or becoming consolidated. Another method is, to apply the potassa fusa not over the venous trunks leading from the disease, but over the varix itself, and at different points, using it so freely as to induce sloughing of the veins together with the surrounding tissues. A third method, suggested and practised by Mr. Mayo, consists in applying the caustic over the vein, but not so freely as to induce a slough; the object being to bring on fibrinous phlebitis, and thereby to cause permanent obstruction. A fourth mode is, the application of the Vienna paste—a compound of five parts of quick lime, and four of caustic potash made into a paste with spirits of wine. It is applied to various parts along the course of the diseased veins, the surrounding parts being protected by some plaster; the diameter of each part to which it is applied should be about one-third of an inch, the number of parts varying according to the extent of the disease; and the length of time during which the application should be continued is about half an hour.

Such are the principal methods which have been employed for the

radical cure of varices, and such the different opinions entertained as to the process, by which each is expected to conduce to the end desired. Division, as practised by Sir Benjamin Brodie, cauterization by means of the Vienna paste, and obstruction by pressure by means of a needle and twisted suture as proposed and practised by M. Velpeau, are the methods most favourably regarded; and of them all, the subcutaneous section of the veins as practised by Brodie, I should think the least hazardous, and consider warrantable and advisable, when the disease gives rise to great discomfort, or threatens dangerous hemorrhage; but in all other circumstances it appears to me to be a matter of very questionable propriety, to venture upon a proceeding which endangers the life of a patient, merely to relieve him of an inconvenience.

I consider that in the great majority of cases, the palliative treatment is preferable to any of the methods proposed for effecting a radical cure.

CHAPTER XIII.

DIFFERENT KINDS OR CLASSES OF ABDOMINAL HERNIÆ.

ABDOMINAL herniæ, or ruptures, are usually divided, if their condition is taken as the basis of arrangement, into *three* classes; namely, *reducible*, *irreducible*, and *strangulated*; or, if they are arranged according to situation, into four; namely, *inguinal*, *femoral*, *umbilical*, and *ventral*. It will help to a clearer understanding of the subject, if we consider these two divisions separately, giving under the first, the general doctrines of hernia, and under the second, the different forms of hernia, as they present themselves in the living body.

REDUCIBLE HERNIA.

Definition.—A hernia is reducible, when it can be easily returned into the cavity of the abdomen.

Symptoms.—In reducible hernia there is a swelling, which presents the following characters:—It is unattended with heat, discoloration, tenderness, pain, or even uneasiness, except when the tumour first takes place, at which period an uneasy sensation of weakness in the parts is in some instances complained of. The swelling begins from above, and gradually descends; it is brought on by the erect posture, coughing, sneezing, pressing on the abdomen, or by any exertion of the abdominal muscles or diaphragm; and it disappears in the recumbent posture, or when gentle pressure is applied. During coughing it becomes larger and tense, and communicates a sudden impulse to the hand of the examiner. These symptoms may be observed in every reducible tumour; but there are others, which, although more variable, characterize a hernial tumour, and when present, furnish information regarding its contents. If the swelling be elastic, uniform, and compressible, and if its return be sudden and attended with a peculiar gurgling noise (the *gargouillement* of the French writers), there can be no doubt that the hernia is formed of intestine. The smooth surface of the intestine makes its return easy and sudden, and the mixture of air with other intestinal contents gives rise to the peculiar gurgling sound. If the swelling be more solid and uneven,—if it feel heavy to the patient,—if it be doughy to the touch, and receive an impression from the fingers of the examiner, and if its return be gradual and unattended with any peculiar sound, there can be no doubt of its being an omental hernia. When omentum forms the hernia, its surface becomes moulded by the surrounding parts, and in consequence, its return into the abdomen is gradual. If a portion of the swelling be elastic, and return suddenly with a gurgling noise; and if the remaining part be doughy, and its return more

gradual and less easily accomplished, the hernia is in all probability formed of intestine and omentum. These discriminating symptoms, when well marked, as they usually are in hernia of short standing and moderate size, furnish very satisfactory information regarding the contents of the hernia; but if the hernia be small, it is often difficult and even impossible to arrive at a decided conclusion as to its contents; and if it be of long standing, there is frequently the same difficulty, since the thickening of the hernial sac, and the adhesion of the parts of the hernia to each other, and change of structure, diminish the accuracy of any nice discrimination by the touch. When the hernia is formed of intestine alone, it is called an *Enterocoele*; when of omentum alone, an *Epiplocele*; when of both intestine and omentum, an *Enteropiplocele*; and when of a redundant portion of bowel in the form of a diverticulum, a *Hernia Litrica*.

Treatment.—The treatment of reducible hernia consists in returning it into the abdomen, and preventing its recurrence by the pressure of a truss. A reducible hernia generally goes up of itself, when the patient is placed in the horizontal posture and more especially if the thigh on the affected side be brought a little upwards and inwards, so as to relax the parts about the hernia. When it does not return of itself, it may be replaced by certain manual proceedings, technically called the operation of the *taxis*—the manner of performing which varies in some respects according to the situation of the hernia, as will be explained hereafter. Pressure by means of a truss is employed for the purpose of preventing a recurrence of the hernia. While the patient requires to use a truss, the treatment is palliative or preventive; when it has induced such a change as to prevent any tendency to a recurrence of the hernia, the cure is said to be complete or radical. There is no period of life at which a truss may not be used. At one time it was supposed that it could not be applied to a child; but it is now ascertained that if a truss be sufficiently weak, it may be worn by the youngest children without inconvenience; and as a complete or radical cure is readily produced in early life, it is of the greatest importance that the application of a truss should not be delayed. The only condition of parts in early life which forbids the use of the truss is the testicle not having descended through the inguinal canal. The pressure and thickening of parts, under these circumstances, might present an obstacle to the descent of the testicle, and cause its permanent retention in the abdomen; but fortunately this condition of the testicle is of rare occurrence. If, however, it should present itself in a case of reducible hernia, the application of the truss ought to be delayed until the testicle has made its way into the scrotum.

In regard to the use of a truss, the following points are highly deserving of consideration:—

1. The different ways in which the use of a truss produces a complete cure of hernia.
2. The precise situation in which the pressure should be applied by means of a truss.
3. The length of time a truss ought to be employed for the cure of a hernia.
4. The chief sources of inconvenience and irritation from wearing a truss.

I. THE DIFFERENT WAYS IN WHICH THE USE OF A TRUSS PRODUCES A COMPLETE OR RADICAL CURE OF HERNIA.

First.—If a hernia has been very suddenly produced, if it be very small, and if it be very quickly returned, the hernial sac may either return with the hernia, or be gradually drawn back into the cavity of the abdomen. The sac being empty, and no force pressing it downwards, its ascent will be promoted by the elasticity of the peritoneum lining the walls of the abdomen in the neighbourhood of the protrusion, and by the stretching of the peritoneum in various movements of the body, as well as by the elasticity of the hernial sac itself. After the return of the sac, the pressure of a truss sometimes produces sufficient diminution of the opening by contraction, effusion of lymph, and consequent joining of the surfaces, to prevent any future protrusion of sac or hernia. This kind of cure, however, in which the sac returns, and its future protrusion is prevented by the diminution of the opening, is only to be looked for in small herniæ of short standing, and very suddenly produced. If a hernia be of considerable size, and more especially if it be also of long standing, the distension of the hernial sac, and the pressure of the surrounding parts excite a degree of inflammation by which those parts and the sac become adherent to each other, so that the sac cannot be returned into the abdomen, and the kind of complete cure already described cannot take place.

Second.—After the return of a hernia, the sac being empty contracts by its own elasticity, in accordance with the general law, that membranous parts accommodate themselves to the state of their contents. This kind of closure of the hernial sac is analogous to the contraction of the tubular portion of peritoneum, which exists within the inguinal canal for some time after the descent of the testicle. A truss, by approximating to each other the sides of the hernial sac, may assist the natural elasticity in closing up its neck, and in bringing about a radical cure.

Third.—Occasionally the wearing of a truss for a long time produces thickening of the neck of the sac, or of the cellular tissue surrounding it, or of both, and thus interrupts the communication between the cavities and the abdomen, and the hernial sac.

Fourth.—The pressure of a truss often excites adhesive inflammation in the sac, by which its opposite sides become joined together by coagulable lymph, and a recurrence of hernia is prevented. This condition of parts is very frequently found in the bodies of persons who have been subjects of hernia.

Fifth.—According to J. Cloquet the opposite sides of the sac sometimes become adherent without the intervention of lymph, and without the very slightest traces of any inflammation. He supposes that the membrane ceases to secrete the fluid by which it is naturally bedewed; that it becomes dry, and that the sides become adherent without the intervention of any substance. In the ordinary form of adhesion of the opposite sides of a hernial sac, effusion of lymph, thickening of the sac, and traces of adhesive inflammation are perceptible, whereas in this method of complete cure there is immediate union, with thinning of the peritoneum, and the entire absence of all traces of inflammatory adhesion.

Sixth.—Paré, Arnaud, and others, record cases in which complete cures were effected by the firm adhesion of the formerly protruded parts to the peritoneum lining the abdomen around the mouth of the hernial sac; and as in these cases trusses had been worn, it was believed that the pressure gave rise to inflammation in the neck of the sac, and that this inflammation, having extended to the membrane lining the cavity of the abdomen, produced the adhesions.

Seventh.—Absorption of the neck and part of the body of the sac sometimes produces radical cure. Surgical observers have described this condition of parts, and I lately had an opportunity of demonstrating it to the students at the School of Medicine in Marischal College, in the body of a person who had worn a truss for many years for the cure of a reducible hernia. Almost the whole of the neck and the upper part of the body of the sac were absorbed, but the remaining portion of its body and fundus were entire, and formed a bag in the scrotum in front of the tunica vaginalis.

II. THE PRECISE SITUATION TO WHICH THE TRUSS SHOULD BE APPLIED.

Since the immediate object which the surgeon desires to accomplish by the pressure of the truss is, to prevent a return of the hernia, and the ultimate object, to induce some of the various changes already described, by which the tendency to its recurrence may be removed, it must be evident that the precise part to which the pressure should be applied is, that where the hernia first quits the abdomen. This point will vary in the different forms of hernia, and will afterwards be explained; but meanwhile it may be stated that before the various changes in the sac, and in the opening by which it quits the abdomen, were clearly understood, by which changes a complete cure of hernia is effected, a very common error which prevailed was, to apply the truss too low instead of exactly over the opening; and in consequence, the advantages of the truss were often not obtained, and moreover various inconveniences, which will hereafter be described, were frequently produced.

III. THE LENGTH OF TIME A TRUSS SHOULD BE WORN.

As the prospect of a complete cure is very different at the different periods of life, it being almost a matter of certainty in young persons, occasionally met with in adults, and not to be expected in elderly persons, there will be a corresponding difference in the length of time that the truss must be worn, as well as in the object of wearing it; the object being at one period merely preventive or palliative treatment, at others palliative treatment and radical cure. In young persons a complete cure is often effected in less than twelve months, in adults seldom under two years at least, and in old persons it is not to be expected. In regard to the time a truss should be worn, Sir Astley Cooper remarks, "You will be asked by the patient when you have applied the truss, how long he is to wear it; tell him to wear it at least two years. He will then ask you whether he is likely to be cured at the end of that time; your answer must be that this must depend upon his age. A young person is generally cured at the end of two years, but it will

be advisable for him to continue to use the truss for three years. If the person be not young, there is not much hope of effecting the cure of hernia by wearing a truss."

The truss should be constantly worn, not only during the day, but also during the night, because although the probability of a recurrence of the hernia is by no means great in the recumbent posture, yet it might be induced by a cough, or any sudden change in the posture of the body in bed, and then the cure would require to be commenced anew from that period. It ought also to be kept in mind that the recurrence of the hernia, after the use of the truss has been commenced, is attended with more risk than before, because if thickening about the neck of the sac or around it has commenced, the hernia is more likely to be irreducible from being surrounded by firmer textures. According to some of the best surgical authorities upon this subject, the only exceptions that should be made to the constant use of the truss are, when it is first applied, and before it is to be laid aside, when it is believed that a complete cure has been effected. When first applied, the truss frequently gives rise to irritation, and heat of the skin, with inconvenience and discomfort from pressure and restraint; and until these unpleasant sensations wear off, which will usually be in a week or two, it may be discontinued during the night, but the patient should even then be careful not to remove it until he is in the horizontal posture, and he ought again to apply it before raising himself from that position. And when it is believed that the cure is complete, the truss may be discontinued at night, before it is entirely laid aside. For some time after the daily use of the truss is discontinued, it is a judicious precaution to wear it whenever the body is more than usually relaxed. When the danger of a recurrence of the hernia is greater, or during any unusual exertion, and during the whole period of wearing the truss, it is proper, on making any violent movement or effort, to afford a degree of support by the hand over the pad of the truss. When it is believed that the cure is complete, the surgeon should make a very careful examination of the part where the hernia came out from the abdomen; and before he sanctions the discontinuance of the truss, he should endeavour to ascertain that no swelling can be felt, and that during coughing, or any exertion of the muscles of the abdomen, there is no sensation of a hernia striking against the finger when applied to the opening.

IV. THE CHIEF SOURCES OF IRRITATION AND INCONVENIENCE FROM WEARING A TRUSS.

The chief inconveniences from the use of a truss arise for the most part from its being too strong, or from the pad being placed in an improper situation, hence the necessity of selecting a truss of the proper strength and length for a patient. It should be strong enough to prevent any recurrence of the hernia, but not to cause any painful irritation of the soft parts. Labouring people and those who are required to use great bodily exertion need stronger trusses than others. The length of the truss is also a matter of great importance, not only that the pad may rest on the precise spot where the hernia came out from the abdomen, but also that it may not rest upon the side of the

pubes, the result of which is apt to be irritation of the soft parts from pressure between the bone and the truss, and swelling of the testicle from compression of the veins of the cord.

IRREDUCIBLE HERNIA.

Definition.—A hernia is said to be irreducible, when it suffers no constriction, and yet cannot be returned into the abdomen. For facilitating the description of this form of the disease, it may be useful to attend successively to the causes which prevent reduction, to the dangers and inconveniences which may arise from irreducible hernia, and to the treatment.

Causes which prevent Reduction.—First. A frequent cause which prevents reduction, is the bulk of the protruded parts in relation to the opening through which they would have to return. The bulk is sometimes, and especially in neglected cases where means have not been used to give a degree of support, owing to the quantity of parts which have come out of the abdomen, but more frequently to the enlargement or growth of the hernial contents. The omentum and mesentery are the parts which when protruded present the impediment to reduction from growth; and their increase is occasioned mostly by the deposition of fat in the portions of these tissues, external to the opening through which they came out from the abdomen. Where they are embraced by the opening, the pressure prevents enlargement in that situation; but from the yielding nature of the textures external to the opening, the increase of volume is often very considerable. In old irreducible herniæ the omentum is not unfrequently found to be affected with thickening and hardening, caused by the effusion and organization of coagulable lymph.

Second. Constriction of the neck of the hernial sac is occasionally the obstacle to reduction. That this condition of the neck of the sac sometimes exists to an extent sufficient to constitute, without an operation, an insuperable impediment to reduction, is a point regarding which surgeons are agreed, numerous instances having been recorded by the great surgical authorities of this and other countries, and examples occurring frequently in the practice of many surgeons. Not only is the sac necessarily narrower at the neck than in any other situation, from the manner in which it is embraced by the surrounding textures, but it is liable to be still further diminished by changes without and within the sac, and in the nature of the sac itself. For a minute description of these changes, the conditions under which they most frequently take place, and the nature of the action by which they are produced, I beg to refer to the section on the anatomy of the hernial sac, and the seats of stricture in the different species of hernia; and meanwhile, I shall only remark that thickening and induration of the cellular tissue around the sac, effusion and organization of lymph without, and often also within the sac, and a thickened and indurated state of the sac itself, are the principal conditions which, separately or in various degrees of combination, diminish the canal of the sac, so as to prevent reduction. There can be very little doubt, that these changes are produced by the pressure on the neck of the sac, causing a slight degree of inflammation,

which terminates in effusion of coagulable lymph, and that the lymph afterwards becoming organized, occasions the constriction. Although constriction, when sufficient to render a hernia irreducible, is usually, yet it is not invariably, at the neck of the hernial sac; a fact of little practical moment, if a hernia be merely irreducible, but of the greatest importance, if it be strangulated and require an operation, the object of the operator being to divide the constriction in order to relieve the symptoms of strangulation.

Third. Adhesions of the protruded parts to the hernial sac often constitute the impediment to reduction. Of these adhesions there are three varieties;—

1. The protruded parts sometimes adhere to the sac through the medium of a layer of coagulable lymph. This form was described by Scarpa as the gelatinous or glutinous adhesion, and as this is a condition of parts which very quickly takes place, the surgeon should endeavour to reduce the hernia as soon as possible, in order to prevent the slight inflammation which gives rise to the effusion.

2. Adhesions sometimes assume a membranous or filamentous appearance, varying greatly both in the number and length of the filaments,—in the number, from a single band to several, and in length, from two or three lines to an inch and upwards as a general rule. Adhesions of this form are found only connecting movable parts with each other, as the intestine with the hernial sac, or with the omentum; and they are precisely similar to the bands we often find between serous surfaces in other parts of the body. They are produced by the effusion of coagulable lymph, which ultimately becomes organized—therein differing from the last-mentioned form—and which is drawn out into bands or filaments by the movements of the intestines. This accounts for their being found chiefly connecting movable parts with each other, and for their being more frequent in the body and fundus of the sac than at its neck or mouth, where the parts are in a more confined space, and have less motion. This is now the almost universally received opinion of the origin of the membranous or filamentous adhesions. A different theory, however, is held by Scarpa, who says:—"I am of opinion that the formation of this filamentous or membranous adhesion is constantly preceded by a slight attack of adhesive inflammation, with immediate union of the intestine or of the omentum with the hernial sac; a superficial union indeed, but in progress of time—especially from the intestine separating gradually from the hernial sac by its own vermicular action, by the considerable distension produced in it by the interruption of the fæces, by its proper contractile power, and that of the mesentery, by the interposition of serum always collecting in the sac—the thin covering of the intestine, corresponding to the points of superficial adhesion with the hernial sac, yields and elongates, so as to form at last one or more filaments, bridges, or membranes interposed between the intestine and the sac of the hernia." In short, Scarpa's opinion was, that they are formed of elongations of portions of the serous coat of the intestine.

3. The third form of adhesion, which usually receives the name of the fleshy, is like the gelatinous and membranous, in being the result of adhesive inflammation, but differs from them, inasmuch as the union is

close, firm, and deep, so that the protruded parts and the sac cannot be separated from each other, but form a solid mass, the vessels of which are continuous.

In a case of strangulated hernia, the subject of operation, this form of adhesion demands a very different method of procedure from the gelatinous or membranous, as will be explained in the section on that subject. This species of adhesion is very frequently met with between omentum and hernial sac, and then is generally at the body and fundus of the sac; but when it is found between intestine and sac, which is a very rare occurrence, it is usually at the neck.

Scarpa has described this form under the name of the unnatural fleshy, to distinguish it from what he calls the natural fleshy, which is of an entirely different character, and will be afterwards described.

The three forms of adhesion agree with each other in being caused by inflammation, and in being attended with effusion of lymph; but they differ, inasmuch as the lymph in the first form is not organized; in the second, it is organized and elongated into bands or filaments; and, in the third, although organized, it is not elongated, but effused between the sac and protruded organs, and between the tissues of these parts, so as to convert them into a solid inseparable mass, the vessels of which are continuous.

Fourth. Adhesion of the protruded parts to each other often forms the impediment to reduction. The parts which form a hernia often glide down separately, and to a great extent, into the sac, and afterwards by pressure and various accidental causes, become adherent to each other, and cannot in mass be returned through the opening by which they separately left the abdomen.

Fifth. Membranous bands across the sac constitute an insuperable obstacle to reduction. In reference to these bands, Sir Astley Cooper remarks,—“They appear to be produced in the following manner: during the reducible state of the hernia, inflammation takes place, both in the contained parts and in the inner surface of the sac; but by using proper means, the protruded parts are reduced, and the sides of the sac collapse and adhere together. However, while the adhesions are still recent, a fresh descent takes place from the abdomen, and the hernial contents again disunite the surface of the sac everywhere, except at the points of union of the inflamed parts, the cementing lymph of which instead of bursting asunder, elongates with the fresh pressure, and forms those membranous bands, which are seen passing from one side of the sac to the other. Between these the intestine and omentum get entangled, a circumstance which adds so much to the difficulty of reduction, as to make it, in general, considered as impracticable; but unless the hernial contents themselves adhere, there appears no reason why the means already pointed out, may not here also prove successful. After all, there is scarcely a possibility of detecting by the feel, this variety of the disease in the living subject.”

Sixth. The obstacle to reduction is sometimes furnished by the natural means of connexion between the intestine before its descent, and the peritoneum lining the surrounding part of the abdomen. It is of the greatest importance that the surgeon should have clear and distinct

ideas of this condition of a hernia, for if it be not understood, and if an irreducible hernia of this kind should become strangulated and require an operation, the most dangerous errors may be committed.

Scarpa gave an exceedingly clear and full explanation of this condition of a hernia; it has also been described by Pelletan, Cloquet, and Hesselbach, and with great distinctness by Mr. Lawrence. Pott, in two parts of his valuable work, refers to the difficulty of reducing certain herniæ, where there is reason to believe the obstacles to reduction arose from this condition; but from the manner in which he expresses himself, it is not evident that he understood the real cause of the impediment. The natural means of connexion of the hernia to the surrounding parts, may form the obstacle to reduction on the right side, if the hernia be formed of the cæcum, or head of the colon; or on the left, if it be formed of the sigmoid flexure of the colon. These divisions of the alimentary canal are completely covered by peritoneum, laterally and anteriorly, but are destitute of a peritoneal covering behind; and the peritoneum is reflected from their lateral aspects to the parietes of the abdomen in the ilio-lumbar regions, with which the parietes is connected by loose cellular tissue, capable of great dilatation. The natural means of connexion of these divisions of the alimentary canal with the parietes, are short, and formed of peritoneum, between that portion of it which furnishes a serous coat to the intestines, and that which lines the walls of the abdomen. If these portions of alimentary canal descend to form a hernia, they will drag along with them the part of the peritoneum which naturally lines the parietes of the ilio-lumbar region, to form the hernial sac; and if the hernial sac descend into the scrotum, and there form adhesions to the surrounding parts, the portions of peritoneum which, within the abdomen, preserved the intestine in its natural relations to the walls of the abdomen, will now retain it in the sac; and, as through the medium of these portions, the hernial sac and serous coat of the portion of intestine which forms the hernia, are continuous with each other, it is evident that the reduction must be impracticable. It is as impracticable, under these circumstances, to return the intestine as it would be to return the testicle into the abdomen; the intestine draws peritoneum along with it to form a hernial sac, and the testicle draws peritoneum to form tunica vaginalis; and the serous coat of the intestine has the same relation to the hernial sac, as the tunica vaginalis reflexa has to the tunica vaginalis propria.

Such a hernia, when it becomes strangulated, and an operation is to be performed, requires a particular method of treatment, which will afterwards be explained.

DANGERS AND CONSEQUENCES WHICH MAY RESULT FROM IRREDUCIBLE HERNIÆ.

The chief dangers which may result from irreducible herniæ are, inflammation of the hernia, laceration or injury of the intestine from violence, extreme inconvenience from its size, and strangulation.

The chief source of anxiety, however, in irreducible hernia is the risk of its becoming strangulated—a state in which the life of the patient is placed in the most imminent danger. The symptoms of this state, the

condition on which they depend, and the treatment requisite, will be explained under the head of Strangulated Hernia.

Irreducible herniæ, even when left to themselves, do not always attain a great size; and sometimes they give rise to no inconvenience whatever, beyond a sense of weight and fulness in the parts affected. Sometimes they render the subjects of them liable to occasional colic pains, and derangement of the digestive organs, but in other instances these symptoms do not present themselves.

TREATMENT OF IRREDUCIBLE HERNIÆ.

From what has been stated of the causes which render herniæ irreducible, and of the dangers which may result from them, the indications and rationale of treatment may be very easily understood. In every case the diet should be carefully attended to, and everything avoided which would be apt to produce derangement of the digestive system, and the bowels should be preserved free from constipation, as a loaded condition of the alimentary canal would, by increasing the distension, be likely to cause an increase of the protrusion; in short, the intestinal canal should, as much as possible, be preserved in a regular and natural state.

The hernial tumour should be carefully defended from any injury by external violence, and the greatest precaution taken to avoid every kind of exertion, by which an addition might be made to the protrusion, or the parts already protruded be injured, or their condition in any way changed. To retard the growth of the hernia, and to diminish the probability of its proceeding to such a size as to cause inconvenience, the tumour should if possible, be supported by means of a suspensory bandage; and if it has already attained great size, by a suspensory laced bag, by which an increase of the hernia is sometimes prevented, and its size diminished by absorption. These precautions may be said to constitute the proper treatment of an irreducible hernia; and however little inconvenience a hernia may occasion, they ought never to be disregarded.

As greater risk attends an irreducible than a reducible hernia, various means have been proposed and adopted for removing the obstacles which oppose reduction.

Of these the principal are,

1. The diminution of the size of the hernia by producing emaciation.
2. The absorption of part of the hernia by the application of pressure.
3. The application of cold; and
4. An operation.

1. Fabricius Hildanus records an instance of a man who was cured of a hernia of twenty years' standing, by six months' confinement to bed; and Arnaud gives an account of several cases, in which very large herniæ had entirely disappeared after the patients had become much emaciated by long confinement with tedious illnesses. Impressed by these instances, Arnaud endeavoured to effect radical cures in certain cases by an imitation of this process of Nature. The means he employed were, confinement to bed, restriction of diet, occasional venesection, and the frequent exhibition of purgatives and clysters; and in numerous

instances he succeeded in accomplishing reduction. The late Mr. Hey of Leeds reduced several herniæ by the same means, and states that usually the cure occupied six weeks, but in one instance it was accomplished in a week.

While a hernia is merely a source of present inconvenience, and little apprehension is experienced of what may be its future consequences, few patients will submit to a method of treatment which is attended with so much discomfort, and requires so much self-denial; besides which, to a patient of advanced age, this method might give rise to serious results, and in such circumstances, therefore, a prudent practitioner would hesitate at recommending its adoption. But the great objection to this method of treatment is, that it cannot prove of any service whenever the obstacle to reduction is adhesion in any of its different forms; and since there is no criterion for distinguishing where adhesions do or do not exist, it is almost impossible in any case for a surgeon to assure his patient that it will certainly succeed. The cases in which this treatment is likely to be attended with a favourable result are, those of omental hernia, in which enlargement of omentum from accumulation of fat forms the impediment to reduction.

2. Pressure is another means which has been employed in cases of irreducible hernia, and it has been recommended in cases where the impediment to reduction is enlargement of the omentum from accumulation of fat; but for various reasons which need not be mentioned, it appears to be extremely injudicious to venture on this treatment.

3. By the application of cold, herniæ of considerable standing have been returned.

On this subject Sir Astley Cooper, who proposed this method of treatment, makes the following remarks: "In some cases the application of ice occasionally procures the return of a hernia which appeared irreducible. I was asked by a physician to examine a hernia which had come down about a fortnight before, and had ever since resisted all attempts at reduction, without being painful. I found it was omental hernia, and ordered ice to be kept upon the tumour for a considerable time. In twenty-four hours it was so much diminished as to encourage a perseverance in the plan, and in four days the hernia was entirely removed.

"Mr. G., a surgeon in the East India service, called to show me an omental hernia on the right side, which, though not painful, gave him some anxiety, as it could not be returned, and he was apprehensive of its becoming strangulated at some future time. I ordered him to bed, and put him on the same plan as in the former case, which produced a very gradual diminution of the tumour, and, at the end of five days, its entire removal. It appeared to me in both cases, that the good effects attending the use of the ice, were owing to a consequent contraction of the scrotum, which thus performed the office of a strong and permanent compression of the tumour."

During the spring of 1841, I was very much gratified with the effect of the application of ice, in the case of a person named Kelly, a butcher, then sixty-six years of age. For many years he had been annoyed with a reducible inguinal hernia on the right side, for which he required to

wear a truss. He always succeeded in returning the hernia without any assistance, until about two weeks before I saw him, when it came down, he said, to a greater extent than on any former occasion; but for twelve days it was unattended with pain or any inconvenience, beyond a sense of weight or weakness of the affected part. After it had been down for twelve days, it became, in consequence of some over-exertion, painful and tight; and when I saw him, two days after the commencement of the pain, and two weeks after the descent of the hernia, I found him labouring under the ordinary symptoms of strangulation, which, according to his report, had been much more urgent for the eight hours preceding my visit, than before. The hernia extended down to the middle of the scrotum; and, from the examination, I felt fully satisfied (as did also a medical friend who likewise saw the case) that the hernia consisted partly of omentum and partly of intestine. I instituted the ordinary treatment for strangulation for five or six hours, and thought I should be obliged to have recourse to an operation; but on making a second careful attempt at reduction by means of the taxis, a small part returned very suddenly, and almost immediately he felt relieved, both from the local and general symptoms, and the bowels were soon opened; but still it appeared impossible to return any more of the hernia. I then ordered ice to be kept over the hernia, and in the course of thirty hours from its first application, the hernia entirely disappeared, and the use of the truss was then resumed.

I have often successfully used ice, in conjunction with other remedies, in reducing hernia in different states; but in the present instance, the return of the part which remained after the subsidence of the symptoms of strangulation, when the case presented the characters of a simple irreducible hernia, must have been owing solely to the application of ice, as no other means of reduction were used at the same time. From all I have been able to ascertain from recorded experience, from what I have been told in conversation by others, and from what I have seen in my own practice, my decided impression is, that it is only in hernia of very short standing that the application of ice proves to be of service; and the same conclusion is suggested, independently of observation and experience, by our knowledge that the cause which prevents the reduction of hernia of long standing, is frequently one or other of the forms of adhesions already described, and that on these the application of cold by means of ice could produce no beneficial impression.

4. An operation is the only practicable method of accomplishing reduction, when adhesions are the impediment; and unfortunately, in most herniæ of long standing adhesions do exist.

It may be laid down as a general rule, that as an irreducible hernia is only a source of inconvenience, and exposes the patient merely to the risk of being thrown into a hazardous situation by its becoming strangulated, or giving rise to some of the consequences described in a former section, the surgeon is not justified in performing an operation which puts the life of the patient into immediate and great danger; on the contrary, it is his duty to advise the patient to be satisfied with such palliation of his complaint as may be obtained from the means which have been already pointed out. Still, operations have been per-

formed; but it appears from recorded experience that they have generally proved fatal. The great size which an irreducible hernia often presents, the extent of adhesions, and the consequent danger of the dissection, and great risk of inflammation, are considerations which would deter a prudent surgeon from venturing on an operation, unless some very distressing symptoms should demand it. On this subject, Mr. Lawrence, in his valuable work on hernia, remarks:—"Yet an objection must be made to the general rule of not operating in irreducible herniæ, in behalf of those instances where the tumour occasions such essential inconvenience and suffering to the patient, as to induce him, when the dangers he incurs have been fully represented, to submit to the operation. Such was the case of the celebrated Zimmerman; the omentum adhered by a single filament to the testicle; when the former was replaced, the latter ascended with it, and experienced very painful pressure from the ring; if the parts were allowed to protrude again, a portion of intestine generally followed, was pressed on by the ring, and occasioned a fear of strangulation. The pressure of a truss occasioned such severe suffering, that it could not be borne. In a patient on whom Mr. Abernethy operated, an adherent epiplocele gave rise to frequent protrusions of the intestine, which were highly distressing. A particular source of danger and inconvenience existed in both these cases, and admitted of no remedy but the operation."

STRANGULATED HERNIA.

A hernia is said to be strangulated, when the protruded parts experience such a degree of pressure as not only prevents their return, but also, by compressing their blood-vessels, disturbs or in a measure suspends or impedes the circulation in them. This condition very speedily produces inflammation in the protruded parts, which extends itself from thence to the parts within the abdomen.

Symptoms.—There is pain in the swelling, beginning about the neck, or being at first most considerable there, and propagating itself gradually over the swelling in the direction from the abdomen. The swelling becomes tense, and there is for some time, tenderness on pressure, afterwards pain on pressure, in some instances very acute. In some examples there are heat and redness. Such are in many cases the local symptoms; and if death do not very speedily take place, they occasionally change for a short time before its approach, the swelling becoming flaccid, the pain and tenderness on pressure wearing off, and crepitation being perceptible on examination:—such symptoms denoting the presence of gangrene.

The symptoms connected with the alimentary canal are, eructations, nausea, vomiting, and insuperable constipation of the bowels. At a very early period the patient is troubled with eructations, followed by nausea and vomiting. The contents of the stomach are first vomited, and afterwards, in consequence of inverted peristaltic motion, those of the canal between the stomach and the seat of the stricture. Bilious matter is brought up in large quantities, and the contents of the small intestine, and even of part of the large intestine, if any portion of that division of the alimentary canal should be placed higher up than the part included

in the stricture. When the contents of the large intestine are brought up, the vomiting is called *stercoraceous*. The insuperable constipation is a striking symptom. It may be possible by means of clysters to wash out the portion of canal which is below the hernia; but it is impossible while the strangulation remains, to procure any evacuation from the part of the intestine above the hernia; and this is not owing to a mechanical obstruction offered by the stricture, for the constipation is insuperable when the stricture only diminishes the calibre of the intestine, as well as when it includes an entire fold; and it is insurmountable in cases of omental hernia, after the inflammation has extended to the intestine. The constipation is owing to the same cause as in enteritis or ileus, of which strangulated hernia is an example, though differing from ordinary cases in being produced by a mechanical cause.

There are some symptoms connected with the abdomen, which are quite characteristic of strangulation; namely, a sensation as if a cord were tied tightly round the upper part of the abdomen, twisting pains about the umbilicus, and pain diffused over the whole abdomen, but generally more considerable from the seat of the hernia to the umbilicus. The abdomen after a certain time becomes tense, and, as the disease advances, tender and painful on being pressed, or stretched; and, therefore, the patient lies quite still, with the limbs drawn up to relax the abdominal parietes. After a time, hiccough comes on, and the belly becomes tympanitic. The tongue is white and dry, the countenance pale, anxious, collapsed, and expressive of great suffering; the pulse, which from the beginning is small and hard, becomes very quick, and extremely small and thready; there is great sense of feebleness, the extremities ultimately become cold, and the surface of the body covered over with a clammy perspiration. When gangrene has actually taken place, the patient may experience a sudden and complete relief from all pain and tenderness in the swelling or abdomen; the former may feel emphysematous, a sure sign of gangrenous mischief; it may feel flaccid, or even return on pressure; the abdomen may become free from all tenderness on pressure, but it still remains tense; the patient may feel himself relieved from all suffering, and in many instances even a few minutes before death, patients have expressed themselves as perfectly confident of recovery; but the pulse is extremely feeble, and usually in this state irregular; the clammy perspiration remains, and death very soon closes the scene.

Such are, generally, the symptoms of strangulation; but they are not in all cases of equal intensity or rapidity. When the patient is not advanced in life, when the hernia is intestinal and recent, and when the stricture is tight, the symptoms are alarmingly intense, and present the assemblage already described. In elderly persons, and more especially when the hernia is of long standing, the mouth of the sac probably being widened by the distension occasioned by the protruded parts, the symptoms are usually less urgent and slower in their progress, and for some time their appearance seems to indicate that they are to be referred to obstruction of the alimentary canal rather than to inflammation. There can be very little doubt that in such cases, accumulation of fecal matter from torpor of the intestine is frequently the cause of discomfort, and that the inflammatory process is a consequence arising from it. When the hernia is omental, the symptoms of strangulation

are less violent and slower in progress than when it is intestinal; the pain and sense of constriction in the tumour are comparatively inconsiderable; the pain and tenderness of the abdomen not so urgent; the vomiting not so frequent; and the constipation not by any means so very obstinate; so that the bowels may be moved by enemata until the inflammation has reached the intestine, when, as in a case of ileus, it becomes insuperable. In some cases, but they certainly are extremely few, inflammation in the hernia is the cause of strangulation; but in by far the greater number of examples inflammation is the consequence of the constriction. Under all circumstances, the symptoms of strangulation furnish ground for the greatest alarm. Although cases are often known to go on for several days, others have terminated fatally in a very short time. The works of Larrey, Pott, Cooper, Hey, Wilmer, and others, contain records of cases in which strangulation has been followed by death in less than twenty-four hours. Sir Astley Cooper alludes to a case in which death took place in eight hours after the occurrence of strangulation, and Larrey met with two examples in which only two hours elapsed between the occurrence of strangulation, and the death of the patient. Strangulated hernia has the same general symptoms as ileus and intus-susception, and in addition to these it has its own peculiar local symptoms. The presence of the symptoms above described should always lead to a careful examination of the usual sites of hernial protrusion, and the absence of local swelling in such cases warrants the conclusion that they depend upon a cause which is intra-abdominal. Conditions, however, may exist requiring great care to form a correct diagnosis, namely, the coexistence of ileus with an irreducible hernia, not strangulated, or, the presence of ileus with an ambiguous tumour at any of the ordinary sites of hernial protrusions. The history of the symptoms, the absence of a sense of tension or of pain in the swelling, or of any alteration of the symptoms connected with the tumour, and there being little or no tenderness on pressure, render it extremely probable that the symptoms are independent of the local affection, or that the latter has no casual relation to them. The proper view to be taken of a strangulated hernia, I conceive, is, that it is a species of ileus produced by a mechanical cause.

Treatment.—Strangulation being caused by compression of the protruded parts, an indication of paramount importance is to relieve them from the pressure as speedily as possible. With that view, replacement should in most cases be attempted by a certain manual process, technically called the operation of the taxis. To diminish the tension of the opening, through which the parts are protruded, the patient should be placed in the recumbent posture, with the trunk bent a little forward, and the thigh of the affected side raised upwards and inwards. With the fore-finger and thumb of one hand, the tumour should be embraced at its neck, and replacement attempted by a kneading or pinching movement at that part, while with the other hand the tumour should be subjected to general pressure; the object being, not to push back the hernial contents in mass, but to knead up the tumour, bit by bit; and in doing this, it is necessary to observe the course which the protruded parts must have taken, that the direction of the pressure may be accom-

modated to it. Before attempting to press up the tumour, it is often advantageous to draw the hernia downwards, as if the object were to draw the hernial contents farther from the abdomen. By this proceeding, the neck is rendered straight, and an obstacle, offered by the hernia being much swollen on the aspect of the stricture farthest removed from the abdomen, is diminished, so that the taxis can be employed under more favourable circumstances. The taxis should be employed gently, steadily, and cautiously, without any force or violent effort, and even when used most prudently, it should not be continued for more than eight or ten minutes, nor should it be persevered with after it has been ascertained that there is no reasonable prospect of its employment being successful.

In some cases of strangulation, it would be extremely injudicious to use the taxis at all, or any other means for accomplishing reduction; and in a very few others, it ought not to be employed until the state of the tumour has been changed by appropriate treatment. To the former class of cases belong those in which the hernia has become gangrenous, or in which there is reason to believe that the intestine has become so much softened by inflammation as to be in danger of giving way if returned into the abdomen. In such circumstances, fecal extravasation and death would be the consequences of returning the hernia. The proper treatment of such cases will be explained, when describing the operation for strangulated hernia. The cases in which it is not prudent to use the taxis are by no means numerous. In reference to this practical point, it is important to remember what has been stated in the description of the symptoms of strangulation, namely, that although in the great majority of cases, inflammation is the result of the strangulation, yet in some exceedingly rare cases, the reverse takes place;—the hernia becoming inflamed and swollen, and in consequence, embraced so tightly by the surrounding textures, that its circulation is impeded, and strangulation produced. The prudent procedure is, to endeavour by the application of leeches around the hernia, by general depletion if necessary, by cold applications and other antiphlogistic remedies, to subdue the inflammation; and the cause having been removed or modified, the taxis may then be employed, not only with safety, but also with a more reasonable prospect of success. If symptoms be urgent, however, an operation should be resorted to for the purpose of removing the pressure. The direction in which the hernia should be pressed, during the operation of the taxis, varies in the different species of hernia. Further information on this subject will be given in a subsequent chapter.

In the event of the taxis not being successful, recourse should be had to some of the various means, called auxiliaries to the taxis, and then the taxis should be tried a second time. Of these means, the most useful are bloodletting, the warm bath, the very abundant application of cold, enemata, and chloroform.

Bloodletting is no doubt a valuable auxiliary in certain cases, especially when the symptoms are very acute, and the hernia small, when depression has not come on to a great extent, and when the patient is not at an advanced period of life. It favours reduction, partly perhaps by diminishing the bulk of the hernial contents, though its effect in that

way must be very slight; but principally, and indeed almost entirely, by producing relaxation, and thereby increasing the size of the opening through which the parts have to be returned. Such being the principle of its usefulness, it will be desirable to produce fainting by the bleeding, and with this view, the head and trunk of the patient should be raised to the erect position during the bleeding, and the blood should be taken from a large opening. When fainting is induced, the taxis should be used a second time. Bloodletting is also advantageous, by diminishing the tendency to inflammation after reduction.

The *warm bath* is useful on the same principle as bloodletting, and in the same class of cases; and if the two auxiliaries can be used together, that is, if the patient be bled to faintness in the warm bath, the taxis may then be employed under very favourable circumstances. Unless the bath be sufficiently warm to induce faintness, little or no benefit will result from its use. Delay, however, being so dangerous, this is a remedy which cannot always be employed in private practice, on account of the time which would often be required for its preparation.

The *abundant application of cold* over the hernia is a valuable auxiliary to the taxis, and in various instances it has produced reduction without the taxis. The application must be continued for a considerable time, otherwise it can have no effect. Pounded ice enclosed in a bladder, is one very convenient way of applying cold, and another is by a mixture of muriate of potash and muriate of ammonia. The cold diminishes the bulk of the tumour, and also induces a degree of constant pressure, by the contraction of the textures covering the hernia.

Mild enemata are also useful, more especially in cases of large and old hernia, when strangulation has been brought on by torpor, and a loaded condition of the alimentary canal. The tobacco enema is a very powerful remedy, and in the state of extreme relaxation which it brings on, the taxis has been used with success. But as in the state of depression produced by strangulated hernia, the system has but little power to stand out against the lowering effects of this remedy, and as in some instances it has appeared to sink under them, I have never ventured to employ it, and cannot therefore, from my own observation, say anything of its advantages. It appears to me, that this is a remedy which ought never to be employed.

Such, until lately, were the principal auxiliaries to the taxis for accomplishing reduction; and in regard to their employment it is to be remembered, that it is of the utmost importance not to lose time; that in cases where there appears no objection to the use of the taxis, it should be employed cautiously, but decidedly and thoroughly; that in the event of its being unsuccessful, such auxiliary remedies should be adopted either singly or in combination, as in the particular circumstances of the case seem most advisable, and then the taxis should be used a second time; and if it still be without success, that time should not be wasted in the repetition of treatment, which on a full and fair trial has failed, but that the surgeon should then at once recommend an operation.

Such were the views entertained, previous to the discovery of the properties of chloroform, regarding auxiliaries to the taxis and the proper

modes of employing them. The use of chloroform, however, has now superseded the necessity of bloodletting, the warm bath, and enemata. If the patient be brought well under the influence of chloroform, and if on the decided, skilful, and thorough employment of the taxis, the hernia cannot be returned, the surgeon may reasonably conclude that the constriction is too great to be overcome by any means short of an operation. He should therefore spare the patient the danger resulting from delay and unnecessary handling, and at once proceed to the operation.

OPERATION FOR STRANGULATED HERNIA.

There are some peculiarities with regard to the forms of the incisions and other important points in the operations for the different species of hernia, which will be referred to when the different species are described; but there are some considerations regarding the operation, in general, a correct knowledge of which is indispensable.

Some of the most important of these are—

1. The circumstances under which it is justifiable or necessary to resort to the operation;—2d. The importance of having recourse to operation at an early period, and of abstaining from handling the hernia before the operation, more than is necessary for the fair and skilful use of the taxis, while the patient is under the influence of the most powerful auxiliary—chloroform;—3d. The indications which are to be fulfilled by the operation;—4th. The conditions which render it impossible and those which make it improper, to return the hernial contents;—5th. The mode of procedure in regard to the hernial sac;—6th. The anatomy and treatment of abnormal or artificial anus; and 7th. The treatment after operation.

1st. The operation is justifiable and necessary, when the patient has been brought fully under the influence of chloroform, and when the taxis has been fairly, fully, and skilfully tried, and failed to produce the desired effect. The conviction being thus produced that by no other means than an operation is there hope of saving the life of the patient, it ought to be resorted to as quickly as possible.

2d. From what has been stated as to the condition of the parts in strangulated hernia, it must be evident that much handling or pressure of the hernia must not only give unnecessary pain, but also increase the risk of hurrying on the inflammation to results, which, even though the operation should be performed, would render it unsafe to return the hernial contents. When, therefore, the taxis and other remedies have been fairly and skilfully tried, no advantage can, but considerable injury may, result from the repetition of treatment already found to be unavailing. So deeply was the celebrated Desault impressed with the injurious effects of pressure and handling, that he confided in other means for accomplishing reduction, and entirely prohibited the taxis in cases brought to the Hôtel Dieu, until by other means the parts were brought into a state in which they could be returned with little difficulty.

3d. The indications which are to be fulfilled by operation are two—the first, which is essential for the safety of the patient, is the removal

of the pressure by division of the stricture, and the second, which when possible and proper, is very desirable, is the return of the hernial contents. In many instances, especially when the hernia is small, intestinal, and not of long standing, it returns very suddenly on division of the stricture; in other cases, there are some obstacles apart from the stricture which can very easily be removed; for example, of the four varieties of adhesion mentioned, among the causes which render hernia irreducible, the soft recent adhesion formed by coagulable lymph, called by Scarpa the gelatinous or glutinous adhesion, can be broken down by the finger, and the filamentous adhesion can be divided by the knife.

4th. The principal conditions which render it impossible to return the hernial contents after division of the stricture are two forms of adhesion, namely, the adhesion by the natural means of connexion, and the close organized adhesion, described by Scarpa as the natural and unnatural fleshy adhesions. When either of these conditions exists, the stricture should be divided, and then the coverings of the hernia should be replaced, and proper means taken to heal the wound. Another obstacle frequently met with in hernia of great size is, adhesion to each other of the different parts forming the hernia. In such cases, if the hernia consist of omentum alone, part may be cut away, and the rest returned to the mouth of the sac, the hemorrhage being stopped by pinching the vessels with a forceps, or including them in fine ligatures, while great care is taken not to include any part of omentum along with them. Such are the principal conditions which render it impossible to accomplish reduction; the stricture, however, being divided, the principal cause of danger is removed.

There are certain states in which it would be extremely improper to attempt reduction, namely, when the hernial contents are gangrenous, or when the intestine has given way, from inflammation having gone on to gangrene, or when it has been torn, or accidentally wounded in the operation. The two last-mentioned conditions can only result from unskilfulness in the mode of procedure; but should they exist, the hernia should not be returned. From what has been stated it will be understood that, in all cases in which it is possible, if the intestine be sound and entire, reduction should be attempted. When the intestine presents such an appearance as to render it doubtful whether it can retain its vitality, or whether its return may be followed by fæcal extravasation, the surgeon should content himself with carefully dividing the stricture, replacing the coverings, and using proper means for the healing of the wound.

When the intestine is gangrenous, the stricture should be carefully divided, but in doing so the greatest caution should be observed not to disturb any of the adhesions around the neck of the hernia; the gangrenous portion should be laid open, its contents cleared out as completely as possible, and the coverings replaced; but no attempts made to close up the wound.

There is some difference of opinion among surgeons as to the most prudent method of procedure in regard to the stricture when the intestine is gangrenous. While they agree as to the propriety of opening the intestine and clearing out its contents, some disapprove of any

attempt to divide the stricture, as both unnecessary and injudicious—unnecessary, inasmuch as they suppose that the evacuation of the intestinal contents will in every instance sufficiently remove the pressure; and injudicious, from the risk of destroying the adhesions by which the intestine is retained at the mouth of the sac,—a condition essential for diminishing the danger of fæcal extravasation into the cavity of the abdomen. But others recommend a careful division of the stricture, lest dangerous pressure should still remain; and as it is possible to accomplish division without any risk of breaking down the adhesions round the whole of the neck of the sac, this seems the most advisable procedure, except when the gastric portion of intestine evidently and freely sends down its contents through the wound; in which case division of stricture is not so essential.

Teale, in his admirable work on Hernia, remarks on this subject: "Louis maintained that the division of the stricture was not necessary for the evacuation of the intestinal canal, after a free incision had been made into the gangrenous portion of the intestine;" and Mr. Travers has strongly objected to the division of the stricture under these circumstances, on the ground of its disturbing the adhesions, and being unnecessary for the evacuation of the bowel; nevertheless, he admits that this rule of treatment may have its exceptions. "If," says Mr. Travers, "the stricture should still be sufficient to retain the matters, which will seldom be the case, a moderate dilatation of it will be required." Mr. Lawrence coinciding with Mr. Travers in opinion that the division of the stricture is generally unnecessary, states that if the stricture be so narrow as to interfere with the discharge, an incision must be made to afford the requisite room. To ascertain this point, as well as to discover if there be any interior constriction, Mr. Lawrence recommends that the end of the little finger, or a female catheter, be cautiously introduced into the bowel. Arnaud and Dupuytren divided the stricture, when the fæces did not freely escape. The general practice of Sir Astley Cooper was to divide the stricture. Mr. Key is of opinion "that the danger of disturbing the adhesions has been exaggerated, and states that a director may be passed between the intestine and stricture without materially disturbing the adhesions." In all cases in which the intestine is not entire, whether from having been purposely laid open, or from having given way of itself, or from having been torn or cut by unskilful procedure, it should be allowed to remain, so that the fæces passing off by the wound, may form an abnormal anus, and extravasation into the abdomen be thereby prevented. The wound should be left open to facilitate the free discharge of the intestinal contents, and simple dressings frequently renewed. The anatomy and treatment of artificial or abnormal anus will be afterwards explained.

When omentum forms the hernia, and it is gangrenous, the gangrenous portion may be removed, and the remaining part returned to the abdominal aspect of the mouth of the hernial sac.

These remarks, it is hoped, will be sufficient to point out the proper mode of procedure regarding the hernial contents, when the hernia is sound and reducible, when it is irreducible, and when it is in any of the various conditions in which reduction would be dangerous and improper.

5th. The mode of procedure with regard to the hernial sac.

After the other coverings have been divided by incisions varying according to the situation of the hernia, the sac should be pinched up by means of a forceps, where it is seen to be separated from the hernial contents by some serous fluid, if such separation be perceptible, or where it lies over omentum, if that structure appear to form any part of the front of the hernia, and it should then be opened by holding the knife in a horizontal position. The point of the fore-finger should then be sent up within the sac in front of the hernial contents, and the hernial knife carried up flat upon the finger as a director, care being taken not to allow the edge of the knife to touch the hernia. The stricture should then be divided through the neck of the hernial sac, the direction of the division being from behind forwards. On the return of the hernial contents the sac is usually allowed to remain in the wound, because in most instances it has such adhesions to the surrounding parts as make its return impossible.

It is a question of great importance, in reference to the operation for strangulated hernia, which of the two following modes of proceeding in regard to the hernial sac is the more advisable; namely, that of opening the sac, and dividing the stricture, from within, or that of dividing the stricture and replacing the parts without opening the sac. Of these two, technically called the *intra-peritoneal* and *extra-peritoneal* modes of division, the former is that, which, except in a limited number of cases, has received the sanction and adoption of most surgical authorities in these islands. It appears certain that, in the great majority of cases, it is by that mode alone, that it is possible to accomplish the two grand indications which it is desirable to fulfil by the operation; namely, the removal of the pressure by division of the stricture, and the return of the hernia. The fulfilment of the former, namely the removal of the pressure by division of the stricture, is essential to the safety of the patient: and that of the latter, the return of the hernia, exceedingly desirable when practicable and proper.

With regard to the *FIRST* indication, when the stricture is external to the sac, as is not unusual, it is possible to divide it by adopting either mode; but if formed by the sac, or within it, it is clear, that by intra-peritoneal division alone can the more important indication be fulfilled, or any good effected. Cases belonging to the latter class are by no means of unfrequent occurrence. That the neck of the hernial sac occasionally constitutes the stricture, is a point regarding which surgeons are agreed, instances having been recorded by the great surgical authorities of this and other countries, and examples occurring frequently in the practice of many surgeons. The sac, necessarily narrower at its neck than in other parts, is liable to be still further diminished by effusion and organization of lymph, either on its outer or inner surface, as well as by a thickened and indurated state of its own substance,—conditions which, separately, or in various degrees of combination, diminish the canal of the sac. For eighteen years I have availed myself of every opportunity of examining the condition of hernial sacs, and from my dissections I am led to conclude, that, in herniæ of considerable standing, thickening of the neck is of frequent occurrence. Although constriction, when sufficient to render a hernia irreducible, is usually at the

neck of the sac, yet it is not invariably so. This fact is of little practical moment if a hernia be merely irreducible; but it becomes of the greatest importance if it be strangulated, and require an operation, as the paramount object of the operation is to divide the constriction, in order to relieve the symptoms of strangulation.

The stricture is occasionally found within the sac. In a very few instances it has been found to be occasioned by a loop of intestine; in some by a band of omentum; and in others by a band of lymph effused from the serous coat of the intestine, and surrounding and constricting it as by a ligature.

This last-mentioned condition has been described and delineated by Sir Astley Cooper. It has also been met with by other surgeons; and not fewer than four cases of it have come under my own observation.

The *first* case was that of a female about sixty years of age, of a full habit of body, and the subject of a strangulated umbilical rupture. Her medical attendant, a surgeon of long standing in Aberdeen, found it necessary to have recourse to an operation, and of that I was a witness. The hernia returned very suddenly as soon as the margin of the umbilicus was slightly divided; but the symptoms of strangulation continued, and the patient died in ten hours after the operation. I was requested to conduct the post-mortem examination; and, on opening the abdomen, found behind the umbilicus a swelling about the size of a small orange, formed of intestine, with a neck surrounded by a band of lymph, which embraced and constricted the part as by a cord. The lymph had been effused from the serous coat of the intestine in consequence of the inflammation excited by the pressure of the margin of the umbilicus. In this case the hernia returned, but without the stricture having been divided.

The *second* case was that of a female, a patient of my own, about the middle period of life, on whom I had occasion, with the assistance of Mr. Paterson, surgeon in Aberdeen, to perform the operation for strangulated femoral hernia. On carrying up the point of my finger between the hernia and the hernial sac to feel for the stricture, I was struck with the circumstance, that the tightness of what I supposed to be the stricture, bore no ratio to the extreme urgency of the symptoms of strangulation, and that, after dividing some of Poupart's ligament, by cutting from within the hernial sac, the intestine, on being gently pressed, still remained as tense as formerly, and its contents did not seem to be moved by the pressure. I therefore examined the neck of the hernia with my finger, and perceived a band of lymph keeping the part tightly constricted, and, in short, constituting the stricture. I gently drew down the intestine, and cut the band in several different parts, when the contents of the intestine could be easily made to move upwards. On being satisfied that all constriction was removed by dividing the band of lymph in various parts, the intestine was returned into the abdomen, and the patient recovered without an unfavourable symptom. If the hernia had been returned without this band of lymph having been discovered and divided, the object of the operation would have been unaccomplished.

The *third* case was that of a female, about sixty years of age, of a

remarkably full habit, and who about two days before I saw her, had been seized with symptoms of strangulation. When I first saw her, the abdomen was tympanitic to a great degree; the vomiting was most distressing; the bowels had not been moved for five days, and she had every symptom of sinking very rapidly. She stated that she had often on previous occasions had attacks of what she believed to be colic, and imagined at first that the illness from which she was suffering was only a return of that disorder, and, consequently, anticipated a speedy recovery. I was also informed that, for a considerable time, she had a disagreeable feeling of tenseness in her left groin, though without swelling so far as she could perceive; and that, some hours before I was called, while drawing up her limbs in a fit of retching, she felt, to use her own expression, as if something had given way in her groin, and from that moment was relieved from all feeling of tenseness. The symptoms of strangulation, however, continued. I made a most minute examination of all the usual seats of hernia, but could detect no symptom of such a lesion. I requested my colleague, Professor Macrobin, to attend the patient along with me, which he did, and he was also present at the post-mortem examination. On opening the abdomen, there was at its lower part a small tumour of intestine seen, before any parts had been disturbed beyond merely turning down the abdominal parietes. It was of a livid colour, about the size of a walnut, and with a narrow neck, tightly embraced by a band of lymph, by which it was so constricted as to make it difficult to pass a probe from that part of the intestine which led to the swelling into that which constituted the tumour. The intestine was also twisted over itself in form of a loop. On examining the femoral canal of the left side, a hernial sac was found in it; and the tumour of intestine had, no doubt, formed a hernia, but returned of itself. The stricture, however, formed by a band of lymph, still remained. Sir Astley Cooper records a case in which Mr. Weston returned a hernia by the taxis without an operation; but the symptoms of strangulation continued, and it was found that the stricture was caused by a band of lymph which embraced the intestine. In the instance of my patient, the hernia returned without any assistance.

The *fourth* case was that of a female, whom I had never seen during life, but at the post-mortem examination of whose body I was present, in consequence of the request of a medical man who had seen her a short time before death, and who had also often attended her on previous occasions, when in a state of great suffering from disease of the womb. The symptoms, I was informed, were those usually induced by a strangulated hernia; but the medical man could not detect any swelling in any of the usual seats of hernia. On examining the left groin before opening the abdomen, I thought I felt a very small swelling, which I suspected to be a hernia, and I therefore made a careful dissection of the parts in presence of the surgeon, who requested me to do so, and of one of my pupils. On cutting through Poupart's ligament from before backwards, the contents of a small hernial sac returned into the abdomen without being touched, and were found to consist of intestine strangulated by a band of lymph, embracing the neck of a small hernia. The hernia was not much larger than a walnut. If it

had been discovered during life, and made the subject of operation, there would have been great risk of its returning into the abdomen without the real stricture being discovered or divided.

From what is stated above, it appears very clear that the extra-peritoneal mode of herniotomy is quite unsuitable when the stricture is formed by the sac or within it, whatever be the nature of the stricture itself; and the above-mentioned examples of strictures formed by membranous bands, suggest very strongly the propriety of great caution in arriving at the determination of adopting the extra-peritoneal division; as well as, in those cases in which the sac is opened, of examining very carefully before the hernia be returned, whether membranous bands do or do not exist.

The SECOND indication which it is desirable to fulfil by an operation, is the return of the hernia.

With a view to facilitate the inquiry, as to which of the two modes of procedure is the more suitable, cases may be arranged into the three following classes:—

First, Those in which the stricture is external to the sac, in which it is neither impracticable nor improper to return the hernia, and in which no obstacle exists to that return after the stricture has been divided. Secondly, Those in which an obstacle does exist after division of the stricture: and, Thirdly, Those in which the return of the included intestine would be practicable, but improper.

First, In cases belonging to the first class, either mode is applicable; but extra-peritoneal division being attended with much less danger, is decidedly preferable.

Secondly, In regard to cases in which, independent of the stricture, an obstacle to reduction exists, it will be proper to consider what are the principal obstacles most frequently met with. These are adhesions of the protruded parts to the hernial sac, the natural means of connexion, in some rare cases; adhesions of the protruded parts to each other; and the large size of the hernia.

For a description of these obstacles to reduction, the reader is referred to the section on irreducible hernia.

If any of these conditions exist, and if the sac be not opened, reduction is in general impracticable. If the sac be opened, two of them may easily be overcome; namely, the soft recent adhesions, formed by coagulable lymph and the filamentous,—the former can be broken down with the finger, the latter divided by the knife. Two of them present an insuperable impediment to reduction; namely, the natural means of connexion, and the close organized adhesions, if these be to a great extent, and the hernia large. With regard to the two remaining conditions, the possibility of overcoming them, and the propriety of attempting to do so, must depend entirely on the particular circumstances of the case; but frequently, it is more judicious not to interfere with them, unless they exist only to a limited extent, and in herniæ of moderate size. Most of these conditions, however, are principally met in cases of large and old hernia; and, on account of the risk of injuring the intestine in attempts at reduction, as well as that of inducing dangerous inflammation by much handling of the intestine, and the difficulty of

maintaining the parts reduced, even should reduction be possible, the majority of surgeons seem now disposed to follow the advice of Sir Astley Cooper regarding such cases. His practice was, to divide the stricture, which fortunately in such cases is, for the most part, external to the sac, and to leave the latter unopened, and the hernia unreduced. The stricture being divided, the principal cause of danger is removed. The coverings of the hernia should be replaced, and proper means taken for promoting the healing of the wound.

Thirdly, There are certain states in which it would be extremely improper to attempt reduction; namely, when the hernia is gangrenous, or when the intestine has given way from inflammation having gone on to gangrene, or when it has been torn, or accidentally wounded in the operation. The two last-mentioned conditions can only result from unskilfulness in the mode of procedure; but, should they exist, the hernia ought not to be returned. When the intestine presents such an appearance as to render it doubtful whether its return may be followed by faecal extravasation, the surgeon should content himself with carefully dividing the stricture. In all cases in which the intestine is gangrenous, or not entire from whatever cause, it ought to be allowed to remain, so that the faeces passing off by the wound may form an abnormal anus, and extravasation into the abdomen be thereby prevented. When omentum forms the hernia, and it is gangrenous, the gangrenous portion may be removed, and the remaining part returned to the abdominal aspect of the mouth of the hernial sac. The practice of removing a portion of omentum, when from growth it renders a hernia irreducible after division of the stricture, is a proceeding which, in some cases, may be adopted with advantage. For cases belonging to this class, extra-peritoneal division is of course quite unsuitable. These remarks, it is to be hoped, will be sufficient to point out the proper mode of procedure when the hernia is sound, and reducible after division of the stricture; when it is irreducible after such division—and when it is in any of the various conditions in which reduction would be dangerous and improper; and also to show, that to follow one method indiscriminately in all cases would be unwise; that intra or extra-peritoneal division should be adopted according to the particular circumstances of the case; that in the majority of cases intra-peritoneal division is not only the more suitable mode, but the only one which is safe, or by which any good can be effected; and that the cases in which extra-peritoneal division is suitable are those of very short standing, where there is no reason to apprehend the existence of adhesions, or of an unsound condition of the hernia; and those also of large and old hernia, where the more judicious proceeding is to divide the stricture, and not to attempt reduction.

The plan of not opening the sac, although practised in certain cases by Franco and Paré, was first strongly recommended by Petit, and consequently has been designated the *method of Petit*, to distinguish it from the mode in common use. Petit practised this method as early as 1718. It was subsequently advocated by Garengeot; and, at a still later period, adopted and strongly recommended by Bonnet of Lyons.

In this country it was introduced by the second Monro, who advocated

its adoption in cases of small and recent hernia, and mentioned four cases in which he resorted to that mode of proceeding. In one of them, however, adhesions prevented the return of the hernia, and in two of them he was obliged to cut the neck of the sac. In later times, the same proceeding was adopted by Sir Astley Cooper in cases of large and old hernia, and strongly recommended by him as the decidedly preferable mode in cases of that class. Mr. Lawrence, in his valuable "Treatise on Ruptures," remarks, "The plan of removing the stricture, and returning the prolapsed parts without opening the sac at all, ought, I think, to be more frequently adopted than it has hitherto been, although it appears objectionable as a measure of general use, in the operation for strangulated hernia." To Mr. Key, however, the merit undoubtedly belongs of having recommended a more general adoption of Petit's mode than had previously prevailed in this country. In his admirable "Memoir on the Advantages and Practicability of dividing the Stricture in Strangulated Hernia on the outside of the Sac," published in 1833, will be found much valuable information on this interesting subject. Mr. Luke of the London Hospital strongly recommends this mode, and his success is a decided testimony in its favour. Out of nearly forty patients he has not lost more than two. In October, 1845, when I had occasion to be in London, Mr. Liston showed me a patient in the North London Hospital, in whose case he had adopted this mode; and, in a communication I afterwards received from him, he informed me that he had practised it in a few other instances, and felt convinced of its being the preferable mode when the hernia is small and recent, and when there is no reason to apprehend an unsound state of the intestine. And, judging from the recorded statements of some other distinguished surgeons, this mode seems to be meeting with deservedly increased favour; and I have no doubt will continue to do so, if practised under the limitations already mentioned.

There can be no doubt that intestinal inflammation is the most frequent cause of death after the operation for strangulated hernia. Some of the advocates of Petit's method have assigned as the causes of that inflammation, when the ordinary proceeding is adopted, the exposure of the intestine to light and air, change of temperature and handling. I agree with Mr. Lawrence in ascribing it not to these agents, but chiefly to the long-continued pressure of the stricture, owing to the operation being *too long delayed*, and to an injudicious and *too frequent use of the taxis* previous to the operation. I remember being very much struck with an observation of Desault's; I have not his works beside me at present, but it is to this effect:—"Think well of that hernia which has been little handled and soon operated on." The operation is justifiable and necessary, when the patient has been brought fully under the influence of chloroform, and the taxis has been fairly, fully, and skilfully tried without producing the desired effect. The conviction being thus produced, that by no other means than an operation is there hope of saving the life of the patient, it ought to be resorted to as quickly as possible. Much handling must not only give unnecessary pain, but also increase the risk of hurrying on the inflammation to results which, even though the operation should be performed, would

render it unsafe to return the hernia. When therefore the taxis has been fairly and skilfully tried, on a patient fully under the influence of chloroform, no advantage can, but considerable injury may, result from the repetition of treatment already found to be unavailing. Many considerations show that the operation should be performed as soon as possible, after its inevitable necessity has been found to exist. Delay, like undue handling, increases the risk of inducing such a state of the hernia in consequence of inflammation, as would render its return unsafe. From the circumstance that a hernia may speedily prove fatal, and from the depressed state which comes on in consequence of delay, rendering the patient less able to stand the shock of an operation, will be seen the importance of being as prompt as possible; but there is another, and a very urgent reason—namely, that, if the operation be delayed until intestinal inflammation has been induced within the abdomen, it is far from certain that this inflammation will subside on the removal of the hernia which caused it. I have performed the operation for strangulated hernia, according to the usual mode, a considerable number of times, I believe twenty-three in all, and except in one case, where death occurred in consequence of an attack of phlegmonous erysipelas which commenced after the patient was considered out of all danger) in every instance with success. This success I attribute to two things—namely, avoiding all undue and useless handling, and performing the operation early. My decided impression is, that the reason why the operation is so frequently followed by death, instead of being one of the most successful of the great operations of surgery, is too great delay in resorting to an operation, and the undue and the injurious use of the taxis, even after its adoption has proved unavailing.

6th. Abnormal or artificial anus, its anatomy and treatment. Whenever the intestine is unsound, or not entire, it should be allowed to remain, the safety of the patient in such cases consisting in the formation of an abnormal anus. Lymph is thrown out along the abdominal aspect of the mouth of the sac, by which means the intestine becomes connected to the walls of the abdomen, and the danger of fæcal extravasation is diminished. The portion of intestine leading to the abnormal anus, that is, the upper or gastric portion, sends down its contents, and they are discharged by the wound; their transmission into the lower or rectal portion, that is, the part leading from the abnormal anus, being prevented partly by the contraction of that portion from being empty, and its retraction; but principally by the septum formed by the contiguous portions of the bowel. The completeness of this partition (called by some the spur, *léperon*), and consequently of the hindrance of the passage of the fæces from the one end of the intestine to the other, varies according as the entire diameter of a loop of intestine, or a part of it only, is included in the stricture. If the whole diameter be included, the portions of intestine will be in a measure parallel, and the partition complete. The danger of abnormal anus varies according to the part of the bowel affected. If it be a portion of the great intestine, the only consequences may be discomfort and inconvenience; whereas if it be a portion of the small intestine, and more especially if it be near the commencement of the jejunum, the chyle will run to

waste, and death from inanition probably follow. The upper portion remains open, its mucous membrane in some instances projecting, and discharges its contents into a cavity conical in form, the base being round the breach of the intestine, and the apex at the aperture in the abdominal parietes. An excellent writer on surgery says, "In an abnormal anus of long standing, another phenomenon is observed: the two ends of the intestine retract inwards. Scarpa explained this by a movement of traction exercised on them by the mesentery, which movement, we think, is owing solely to the peristaltic motions of the intestine. There is then formed a membranous canal from the intestine to the surface, called the funnel (*l'entonnoir*), which serves as a way of communication between the two ends of the intestine; and when the spur is not very prominent, but strongly retracted, it ends by bringing about the complete return of the fecal matters into the inferior end, and the spontaneous cure of the artificial anus." Nature thus in some cases effects a cure without any other assistance than attention to regimen and pressure on the external aperture, for the double purpose of preventing protrusion of the mucous membrane, and of presenting an obstacle to the passage of the feces outwards. Desault was the first who effected a radical cure of abnormal anus by surgical treatment; but his method, though successful, is not very generally applicable. To Dupuytren the merit belongs of having devised, and successfully practised, an ingenious and more generally applicable mode of effecting a radical cure. His object was the destruction of the septum, which offers the principal obstacle to the restoration of the normal canal; and the plan which he ultimately adopted for that purpose was, to produce a slough of the septum by subjecting it to pressure between the blades of a screw-forceps; the two blades having been introduced, one into each portion of the bowel, are made to approach each other by the turning of the screw, and the partition deprived of its vitality by pressure ultimately comes away with the instrument, and the principal obstacle is thus removed. Of this method of treatment I have had no experience, but in the hands of Dupuytren it was found to be successful. It should never be ventured upon at an early period, lest the surrounding adhesions, which are so essential, should be broken, and lest the irritation should be so great that the extensive sloughing action produced might endanger the life of the patient. And when it is adopted, the utmost caution should be exercised, its effects should be closely watched, and care taken, especially at first, not to employ compression to such an extent as to cause distressing symptoms. The blades should not be introduced very far, lest by too extensive destruction an opening be made into the cavity of the abdomen, or lest a loop of intestine be included between the parts. The restoration of the canal is also promoted by the occasional introduction of tents or bougies into the inferior portion of the canal. Dupuytren's method of treatment is clearly most applicable to those cases, in which the two portions of bowel are parallel to each other.

7th. Treatment after the operation for strangulated hernia.

After reduction it is advisable in general to give an opiate, and suitable means should be employed for promoting the healing of the wound:

strict attention to rest, the recumbent posture, and the careful regulation of the diet, are indispensable. After some little time, it is advisable to endeavour to procure evacuation of the bowels by means of mild enemata; but on no account whatever, should purgative medicines be given by the mouth for some considerable time after the operation. If inflammatory symptoms should appear, they must be combated by local and, if necessary, general depletion, fomentations, attention to regimen, the exhibition of calomel and opium, and other appropriate remedies. Pressure over the wound should be kept up by means of a compress and bandage; and before the patient is allowed to get out of bed and resume the erect posture, by means of a truss to diminish the danger of reprotrusion.

THE DIFFERENT KINDS OF HERNIA, WHEN SITUATION IS MADE THE BASIS OF ARRANGEMENT.

When situation is made the basis of arrangement, it is usual to divide herniæ in accessible situations into four principal classes—namely, *inguinal*, *femoral*, *umbilical*, and *ventral*.

I. INGUINAL HERNIA.

In the language of surgery, inguinal hernia is a generic term, comprehending five different species—namely, *oblique*, *direct*, *congenital* and *encysted congenital* inguinal hernia, and *hernia infantilis*. These species, though all connected with the inguinal canal, yet differ from each other in their anatomy, relations, seats of stricture, &c., and each, therefore, requires to be particularly described.

[But before entering into a special description of each, it may be proper to glance at the anatomy of the parietes of the abdomen, and particularly of those parts concerned in inguinal hernia.

In the study of inguinal hernia, it must constantly be borne in mind, that the protrusion occurs at a natural weakness in the abdomen, through which the testicle and spermatic cord descend, towards the completion of foetal life; and it will be useful, therefore, to study the relations of the different lamina of the abdomen, to the cord and testicle; we should not forget, also, in the examination of the parts of a healthy abdomen in which no hernia existed, that the structures would be very much modified by the affection.

We might then say; first, that a knowledge of the different layers of the abdomen is most important, for the cord and testicle are covered by a re-presentation of the same; and secondly, that if the coverings of the cord are understood, there can be no difficulty in understanding those of the protrusion of the most common form, oblique inguinal hernia. The parts can be studied most satisfactorily by making two incisions, each commencing in the linea alba, one inch below the umbilicus, one extending to the pubes, and the other directed towards the crest of the ilium.

Superficial fascia.—When the skin is removed by the incisions directed, a large portion of the superficial fascia of the abdomen is brought into view. It is composed of cellular tissue and capable of being split into layers. Its thickness varies in different subjects, and in different parts

of the abdomen. In fat subjects, the external layer will be found to have much fat contained within its meshes, and in such, therefore, a much deeper incision will be required to divide it. It is continuous with the superficial fascia of the thorax, the thigh and the perineum, and the deeper layer of it will be found to be connected with Poupart's ligament, the crest of the ilium, and the linea alba. Through the layers of this fascia ramify blood-vessels which may be cut in the operation for the relief of strangulated hernia. The principal artery in the lower part of the abdomen, is the *arteria ad cutem abdominis* of Haller, called frequently the external epigastric artery. Branches also of the external pudic arteries, or the veins accompanying, might also be cut, but the hemorrhage would be so slight as not to require a ligature to arrest it.

Imbedded in this fascia near the groin we find the lymphatic glands. They will be found most numerous immediately over Poupart's ligament, and in the upper part of the thigh over the saphenous opening of the *fascia lata*.

"When the superficial fascia is removed, the aponeurosis of the *external oblique muscle* is in view, together with, in the male body, the spermatic cord (in the female body, the round ligament of the uterus), which emerges from an opening close to the outer side of the spine of the pubes. The lowest fibres of the aponeurosis, as they approach the pubes, become separated into two bundles, which leave an interval between them for the passage of the cord or ligament just named. One of the bands, the upper one and smaller of the two, is fixed to the symphysis of the pubes; and the lower band, which forms the lower margin of the aponeurosis, being stretched between the anterior superior spine of the ilium and the pubes is named Poupart's ligament, or the femoral arch. This latter tendinous band has considerable breadth. It is fixed at the inner end to the spine of the pubes, and, for some space outside that process of the bone, to the pectineal ridge. In consequence of the position of the pectineal ridge at the back part of the bone, the ligament is tucked backwards, and its upper surface affords space for the attachment of the other broad muscles, at the same time that it supports the spermatic cord. Poupart's ligament does not lie in a straight line between its two fixed points; it curves downwards, and with the curved border the *fascia lata* is connected. It is owing to the last-mentioned

Fig. 150.



Fig. 150. The aponeurosis of the external oblique muscle and the *fascia lata*.—1. The internal pillar of the abdominal ring. 2. The external pillar of same (Poupart's ligament). 3. Transverse fibres of the aponeurosis. 4. Pubic part of the *fascia lata*. 5. The spermatic cord. 6. The long saphenous vein. 7. *Fascia lata*.

fact that the so-named ligament, together with the rest of the aponeurosis of the external oblique, is influenced by the position of the thigh, being relaxed when the limb is bent, and the converse. Moreover, the change of the position of the limb exercises a corresponding influence on the state of the other structures connected with Poupart's ligament.

"The interval left by the separation of the fibres of the aponeurosis above referred to, is named the *external abdominal ring*, and the two bands by which it is bounded, are known as its *pillars* or *columns*. The space is triangular in shape, its base being the crista of the pubes, while the apex is at the point of separation of the two columns. The size of the ring varies considerably in different bodies; in one case its sides will be found closely applied to the spermatic cord, while, in another, on the contrary, the space is so considerable as to be an obvious source of weakness to the abdominal parietes. It is usually smaller in the female than in the male body.

"Between the pillars of the abdominal ring is stretched a thin fascia, named, from that circumstance, 'intercolumnar;' and a thin diaphanous membrane prolonged from the edges of the opening affords a covering (fascia spermatica) to the spermatic cord and the tunica vaginalis testis. The cord passes through the ring over its outer pillar.

"*Internal oblique muscle*.—After removing the aponeurosis of the external oblique, this muscle is laid bare. The lower fibres are thin, and

Fig. 151.



often of a pale colour. Immediately above Poupart's ligament the outer part is muscular, the inner part tendinous. The spermatic cord, when

Fig. 151. The aponeurosis of the external oblique muscle having been divided and turned down, the internal oblique is brought into view, with the spermatic cord escaping beneath its lower edge.—1. Aponeurosis of the external oblique. 1'. Lower part of same, turned down. 2. Internal oblique muscle. 3. Spermatic cord. 4. Saphenous vein.

about to escape at the external abdominal ring, passes beneath the fleshy part of the muscle. The fibres in this situation varying considerably in direction from those of the rest of the muscle, pass inwards from Poupart's ligament at first nearly parallel with that structure; and, becoming tendinous, they join with the tendon of the transversalis.

"Transversalis muscle.—This muscle does not, in general, extend down as far as the internal oblique, so that the latter being removed, an interval is observable between the edge of the transversalis and Poupart's ligament, in which the transversalis fascia comes into view; and in which

Fig. 152.



the spermatic cord is seen after having penetrated that fascia. The lower edge of the muscle is commonly close above the opening for the cord in the subjacent membrane, while the tendon curves to its inner side. So that the margin of the muscle with its tendon has a semicircular direction with respect to the aperture.

"The tendinous fibres in which the fleshy part of the two preceding muscles end, are connected together so as to form one layer, which is named the 'conjoined tendon of the internal oblique and transverse

Fig. 152. After the removal of the lower part of the external oblique (with the exception of a small slip including Poupart's ligament), the lower portion of the internal oblique was raised, and thereby the transversalis muscle and fascia have been brought into view. The femoral artery and vein are seen to a small extent, the fascia lata having been turned aside and the sheath of the blood-vessels laid open.—1. External oblique muscle. 2. Internal oblique. 2'. Part of same turned up. 3. Transversalis muscle. Upon the last-named muscle is seen a branch of the circumflex iliac artery, with its companion veins; and some ascending tendinous fibres are seen over the conjoined tendon of the two last-named muscles. 4. Transversalis fascia. 5. Spermatic cord covered with the infundibuliform fascia from preceding. 6. Upper angle of the iliac part of fascia lata. 7. The sheath of the femoral vessels. 8. Femoral artery. 9. Femoral vein. 10. Saphenous vein. 11. A vein joining it.

muscle.' This tendon is fixed to the crest of the pubes in front of the rectus muscle, and likewise to the pectineal ridge. It is thus behind the external abdominal ring, and serves to strengthen the wall of the abdomen where it is weakened by the presence of that opening.

"A band of tendinous fibres (Fig. 152), directed upwards and inwards over the conjoined tendon in a triangular form, gives additional strength to the abdominal wall in the same situation, but the fibres of this structure are often very indistinct.

"Where the spermatic cord is in apposition with the preceding muscle, the cremaster muscle of the testis descends over it. The fibres which compose this muscle are, from their colour, more easily distinguished than the other investments of the cord; and this is especially the case in robust persons, or when they are hypertrophied, as sometimes happens in cases of long-standing hernia. The outer part of the cremaster is much larger than the portion connected with the pubes; indeed, it sometimes happens that the latter is not to be discerned even with most careful dissection.

"When observed in different bodies the lower part of the internal oblique and transverse muscles will be found to present some differences in their physical characters as well as in the manner in which they are disposed with respect to the spermatic cord. Thus:—

"*a.* The transversalis, in some cases, is attached to but a small part of Poupart's ligament, and leaves, therefore, a larger part of the abdominal wall without its support. On the other hand, that muscle may be found to extend so low down as to cover the internal abdominal ring together with the spermatic cord, for a short space. Not unfrequently the fleshy fibres of the two muscles are blended together as well as their tendons.

"*b.* Cases occasionally occur in which the spermatic cord, instead of escaping beneath the margin of the internal oblique, is found to pass through the muscle, so that some muscular fibres are below as well as above it. And examples of the transversalis being penetrated by that structure in the same manner are recorded.¹

"*c.* In his latest account of the structure of these parts Sir A. Cooper described the lower edge of the transversalis as curved all round the internal ring and the spermatic cord. 'But the lower edge of the transversalis has a very peculiar insertion, which I have hinted at in my work on hernia. It begins to be fixed in Poupart's ligament, almost immediately below the commencement of the internal ring, and it continues to be inserted behind the spermatic cord into Poupart's ligament as far as the attachment of the rectus.'² With this disposition of its fibres, the muscle would, in the opinion of the last-cited authority, have the effect of a sphincter, in closing the internal ring, and would thus tend to prevent the occurrence of hernia. But the principal object with which the attention of surgeons has been fixed on the muscles in this situation, is in order to account for the active strangulation of hernial protrusion at the internal abdominal ring, and in the inguinal canal.

¹ *Recherches Anatomiques sur les Hernies*, &c., par J. Cloquet, pp. 18 and 23, Paris, 1817. *Inguinal and Femoral Herniæ*, by G. J. Guthrie, plate I., London, 1833.

² *Observations on the Structure and Diseases of the Testis*, second edition, p. 36. Ed. by Bransby B. Cooper, F.R.S. London, 1841.

"Fascia transversalis.—Closely connected with the transversalis muscle by means of the cellular membrane interposed between the fleshy fibres of the muscle, it is united below to the posterior edge of Poupart's ligament, there joining with the fascia iliaca; and on the inner side it blends with the conjoined tendon of the internal oblique and transversalis muscles, as well as with the tendon of the rectus. The fascia possesses very different degrees of density in different cases; in some being little more than a loose cellular texture, while in others it is so resistant at the groin,—towards which part it increases in thickness, and especially at the inner side of the internal abdominal ring—that it is calculated to afford material assistance to the muscles in supporting the viscera. By an oval opening in this membrane the spermatic cord (or the round ligament of the womb) begins its course through the abdominal parietes. This opening, named the *internal abdominal ring*, is opposite the middle of Poupart's ligament and usually close above that structure, but occasionally at a distance of three or four lines from it. Its size varies a good deal in different persons, and is considerably greater in the male than the female. From the edge of the ring a thin funnel-shaped elongation (infundibuliform fascia; fascia spermatica interna, Cooper), is continued over the vessels of the spermatic cord.

"Epigastric artery.—The position of this vessel is one of the most important points in the anatomy of the inguinal region, from the close connexion which it has with the different forms of inguinal hernia and with the femoral hernia. Accompanied by two veins (in some instances by only one) the vessel ascends under cover of the fascia last described obliquely to the rectus muscle, behind which it then proceeds to its ultimate distribution. In this course the artery runs along the inner side of the internal abdominal ring—close to the edge of the aperture, or at a short interval from it. The vessels of the spermatic cord are therefore near to the epigastric artery; and the vas deferens, in turning from the ring into the pelvis, may be said to hook round it.

"The Inguinal Canal.—This, the channel by which the spermatic cord passes through the abdominal muscles to the testis, begins at the internal abdominal ring, and ends at the external one. It is oblique in its direction, being parallel with and immediately above the inner half of Poupart's ligament; and it measures two inches in length. In front, the canal is bounded by the aponeurosis of the external oblique muscle in its whole length, and at the outer end by the fleshy part of the internal oblique also; behind it, is the fascia transversalis, together with, towards the inner end, the conjoined tendon of the two deeper abdominal muscles. Below, the canal is supported by the broad surface of Poupart's ligament, which separates it from the sheath of the large blood-vessels descending to the thigh, and from the femoral canal at the inner side of those vessels.

"The spermatic cord, which occupies the inguinal canal, is composed of the arteries, veins, lymphatics, nerves, and excretory duct (vas deferens) of the testis, together with a quantity of loose cellular membrane mixed up with those parts. The direction of the vessels just enume-

rated requires notice. The artery and vein incline outwards from the lumbar part of the vertebral column to reach the internal abdominal ring, where, after being joined by the *vas deferens* as it emerges from the pelvis, they change their course, inclining inwards along the inguinal canal; at the end of which they become vertical. There are thus repeated alterations in the direction of the vessels; and while at the beginning and ending all are close to the middle line of the body, they are considerably removed from that point where they come together to emerge from the abdominal cavity.

"The coverings given from the constituent parts of the abdominal wall to the spermatic cord and the testis, namely, the cremasteric muscular fibres with the two layers of fascia, between which those fibres are placed (the infundibuliform and spermatic fasciæ), are very thin in their natural state; but they may be readily distinguished in a surgical operation from the investing superficial fascia, by their comparative density and the absence of fat.

"In order to examine the *peritonæum* at the groin it will be best to divide that membrane with the abdominal muscles by two incisions drawn from the umbilicus—one to the ilium, the other to the pubes. The flap thus formed being held somewhat outwards, and kept tense, a favourable view will be obtained of the two fossæ (*inguinal fossæ* or *pouches*) with the intervening crescentic fold. This fold is formed by the cord remaining from the obliterated umbilical artery, which being shorter than the outer surface of the serous sac, projects it inwards; and as the length of the cord differs in different cases, so likewise does the size and prominence of the peritonæal fold vary accordingly.

"The lowest part of the outer fossa will be generally found opposite to the entrance into the internal abdominal ring and the femoral ring, while the inner one corresponds with the situation of the external abdominal ring. But the cord representing the umbilical artery, which, it has been stated, causes the projection of the serous membrane into a fold, does not uniformly occupy the same position in all cases. Most frequently it is separated by an interval, from the epigastric artery, while in some cases it is immediately behind that vessel. There is necessarily a corresponding variation in the extent of the external peritonæal fossa.

"Between the peritonæum and the fascia lining the abdominal muscles is a connecting layer of cellular structure, named the *subserous cellular membrane*. A considerable quantity of fat is in some cases found in this membrane.

"The relative position of some of the parts above referred to may be here conveniently stated, by means of measurements, made by Sir A. Cooper, and adopted after examination by J. Cloquet. But as the distance between given parts varies in different cases, the following measurements must only be regarded as a general average:—

	MALE.	FEMALE.
" From the symphysis of the pubes to the anter. supr. spine of the ilium,	6½ inches.	6 inches.
From the same point to the spine of the pubes,	1½ "	1½ "
" " to the inner part of the external abdominal ring,	0½ "	1 "

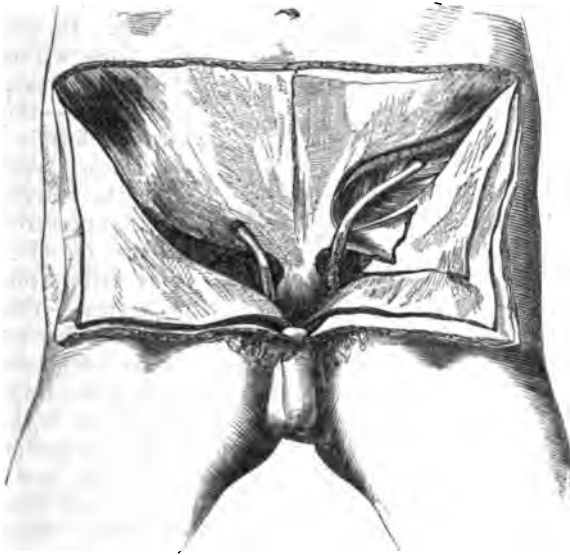
	MALE.	FEMALE.
From the same point to the inner edge of the internal abdominal ring,	8 inches.	8½ inches.
“ “ to the epigastric artery on the inner side of the internal abdominal ring, .	2½ “	2½ “

“From the preceding account of the structure of the abdominal wall at the groin, it will be inferred that the defence against the protrusion of the viscera from the cavity is here weaker than at other parts. The external oblique muscle and the fascia transversalis are perforated, while the two intervening muscles are thinner than elsewhere, and more or less defective. To this it must be added that the viscera are impelled towards the same part of the abdomen by the contraction of the diaphragm and the other abdominal muscles, which occurs in the production of efforts to overcome resistance; and these are the circumstances under which protrusions actually take place.” Quain and Sharpey’s Anatomy, p. 1286–1294.—Ed.]

I. OBLIQUE INGUINAL HERNIA.

This (called by some writers external inguinal hernia) is a hernia which leaves the abdomen at the internal aperture of the inguinal canal. The points which it is of importance clearly to understand regarding this

Fig. 153.



form of rupture will be seen by attending successively to its commencement—direction—coverings—relations to the inguinal canal, spermatic cord, and internal epigastric artery—its seats of stricture—and the operation, when symptoms of strangulation still continue after the employment of all the measures proper for that state.

Fig. 153. Drawing of the parts concerned in inguinal hernia. Taken from a dissection made by me for the surgical class.

1. *The commencement*, as has been already stated, is at the internal aperture of the inguinal canal, where it begins by pushing the peritoneum before it.

2. *The direction* varies in the different divisions of its course. While within the inguinal canal its direction is downwards, inwards, and forwards, so that in using the taxis the pressure should be upwards, outwards, and backwards. After leaving the inguinal canal, its direction is downwards, inwards, and a little backwards. If such a hernia do not

leave the inguinal canal, it is called a bubonocoele; but if it reach the scrotum in the male, it forms what is called scrotal hernia, or oscheocoele; or if the labium in the female, it constitutes a labial hernia:—these appellations being descriptive of the extent of the hernia.

3. *The coverings* of an oblique inguinal hernia, if it extend beyond the external aperture, are six in the male, and five in the female. In the male they are, from within outwards, the hernial sac, formed of peritoneum—the fascia infundibuliformis or internal spermatic fascia, derived from the margin of the internal aperture—the cremaster muscle, called by some writers the fascia cremasterica—the external spermatic fascia—the super-

ficial fascia, and the common integument. In the female the cremaster muscle is wanting.

4. *The relations of an oblique inguinal hernia to the inguinal canal, to the spermatic cord, and to the internal epigastric artery*, are the following. It comes down through the canal, differing greatly in this respect from direct inguinal hernia. The cord is behind, and the hernia

in front, as might be expected, considering the different ways in which the hernia and the cord reach the internal aperture; and the internal epigastric artery is to the pubic side of the neck of the hernia, but



Fig. 154. Hernial sac, showing its usual situation in front of the spermatic cord. From a preparation in my own museum.



Fig. 155. Hernial sac, accompanied by varicocele: showing the spermatic cord split, the vessels lying on one side, and the vas deferens on the other. Taken from a preparation in my own museum.

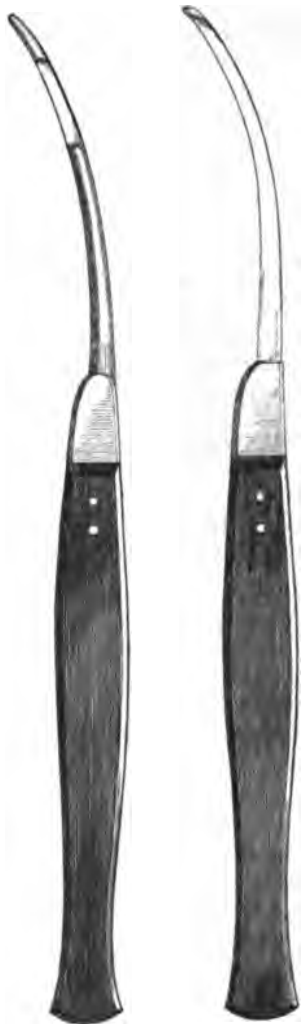
behind the fascia transversalis, and separated by it from the canal. If the hernia be of considerable standing, the different parts composing the cord may be separated from each other, some being bent to one side, and some to the other; and occasionally some have been found nearly in front; but these are deviations from the usual condition. The relation which is the most important of all to be kept in view is, that the internal epigastric artery is on the pubic side of the neck of the hernia.

5. The *seats of stricture* in this species of hernia are three—first, at the external aperture; this, however, is of very rare occurrence, except in cases of large and old hernia, when it is sometimes met with, and may then be formed either by the circumference of the aperture, or by the hernial sac; secondly, between the external and internal apertures, in which case it may be formed by the under borders of the internal oblique and transversalis muscles, or by the hernial sac, or by being embraced by the fibres of the above muscles, the cord and the hernia having in some cases fibres behind as well as in front; and, thirdly, at the internal aperture, in which case it may be formed either by the fascia transversalis where it forms the aperture, or by the hernial sac. The correctness of these statements as to the seats of stricture and the parts by which they may be formed, I have had opportunities of testing in my own dissections and operations.

6. The *operation*. As all the details of the operation for strangulated hernia in general are applicable to the operation for this particular species, I shall here only point out the modifications rendered necessary by the anatomical relations. The incision of the integument should commence about half an inch above the internal aperture, follow the direction of the long diameter of the tumour, and descend to near its base. One simple incision suffices. The next step is, to lay bare the hernial sac by the cautious division of the other coverings, and if intraperitoneal division be the prudent mode of procedure, to open the sac, attending carefully to the precautions already mentioned. The hernial sac having been opened, and the seat of the stricture ascertained by passing the point of the fore-finger upwards within the sac and in front of the hernia, the hernial knife is sent up on the palmar aspect of the

Fig. 156.

Fig. 157.



finger as a director, care being taken to avoid wounding the hernia; and for this purpose it should be sent up with the side resting on the finger until its pointed extremity be within the stricture, when the edge should be turned forwards to the stricture and the division made, during which process the action of the right hand which moves the knife is accommodated to that of the left index finger which to a certain extent guides the knife, and also prevents the hernia from coming against its edge. An important question is, in what direction the stricture should be divided. If the stricture be at the external aperture, or at the under border of the internal oblique and transversalis muscles, there is no artery to be afraid of, and the division can be safely effected by carrying the knife upwards and inwards, directly upwards, or upwards and outwards; but if the stricture be at the internal aperture, there would be danger of wounding the internal epigastric artery if the incision were carried upwards and inwards; it can, therefore, be made with safety only in two directions, namely, upwards and outwards, or directly upwards.

The same proceeding as regards the direction of the incision in dividing the stricture is adopted in all cases of inguinal hernia. It was first recommended by J. L. Petit, and by Scarpa, and afterwards by Richerand, Dupuytren, and other continental authorities; and in this country it was very strongly advocated by Sir Astley Cooper, who recommended in all cases of dividing the stricture, to cut directly upwards—a practice which has deservedly received general adoption.

II. DIRECT INGUINAL HERNIA.

In explaining the anatomy of direct inguinal hernia, we shall follow the same order as in the former case.

Fig. 158.



1. The *commencement* of a direct inguinal hernia is opposite the external aperture, through which it comes usually by pushing the posterior wall of the inguinal canal before it, but in some instances by rupturing a part of it.

Fig. 158. From Druitt.

2. Its *direction* before leaving the aperture is directly forwards; after leaving it, it is the same as that of an oblique inguinal hernia in the corresponding part of its course.

3. The *coverings* of a direct inguinal hernia, from within outwards, are the hernial sac—the fascia transversalis with the conjoined fibres of the internal oblique and transversalis muscles, provided they be not ruptured—a very imperfect covering from the cremaster muscle—the external spermatic fascia—the superficial fascia, and the common integument. In the female, as there is no cremaster muscle, there is one covering less. These coverings differ from those of oblique inguinal hernia in two particulars—namely, that formed by the cremaster muscle is in this case less perfect; and the second from within outwards, instead of being formed by the internal spermatic fascia given off from the internal aperture of the inguinal canal, is formed by the fascia transversalis itself assisted by the conjoined fibres of the internal oblique and transversalis muscles, except when they have been ruptured, or separated from each other.

4. With regard to its relations to the inguinal canal, spermatic cord, and internal epigastric artery, we may remark that it does not come down through the canal, but directly through its external aperture; that the cord, instead of being behind it, is on its outer side; and that the artery, instead of being on the pubic, is on the iliac side of the neck of the hernia. This last peculiarity is most important to be remembered, and it is thus seen that oblique and direct inguinal herniæ have opposite relations to the internal epigastric artery.

5. The *seats of stricture* in this species are only two: namely, at the external aperture—which, however, is a rare occurrence, and then the stricture may be formed either by the circumference of the aperture, or by the hernial sac; and at the under border of the internal oblique and transversalis muscles, the stricture being formed by them, or by the hernial sac itself.

6. After what has been stated regarding the operation for strangulated hernia in general, and that for oblique inguinal hernia, it seems unnecessary to do more than add, that when the stricture is at the under border of the internal oblique and transversalis muscles, the knife in



Fig. 159.

Fig. 159. Drawing of the sac of a direct inguinal hernia; showing the mouth of the sac lying on the pubic side of the deep epigastric vessels, and the spermatic cord split so that its vessels lie behind, and the vas deferens in front of the sac. From a preparation in my own museum.

dividing the stricture could be carried directly upwards, or upwards and inwards, without going in the direction of the internal epigastric artery; but not upwards and outwards. It would be unsafe to cut upwards and outwards in direct inguinal hernia, or upwards and inwards in oblique; and as it is difficult or impossible in some cases to determine whether the hernia be oblique or direct, from the weight of the hernia having drawn down the internal aperture to be opposite the external, it is proper to adopt the rule already laid down—namely, in *all* cases of inguinal hernia, in dividing the stricture to cut directly upwards. It may be briefly stated, that the operation is performed by making an incision through the integuments in the direction of the tumour, and extending from its upper to its under part, and cutting through the other coverings until the hernial sac is brought into view. The hernial sac is then opened, strict attention being paid to the precautions before mentioned. The forefinger of the left hand is

Fig. 160.



then introduced into the sac, and carried up to the stricture, and the palmar aspect of the finger used as a director for conducting the knife up to the stricture, and as a guard to prevent the knife from coming against the hernia. The extremity of the knife having been introduced below the stricture, its edge should be directed towards the stricture, and division effected by cutting directly upwards. The hernial contents should then be returned, if such a proceeding is possible and proper; if not, the treatment formerly described should be adopted.

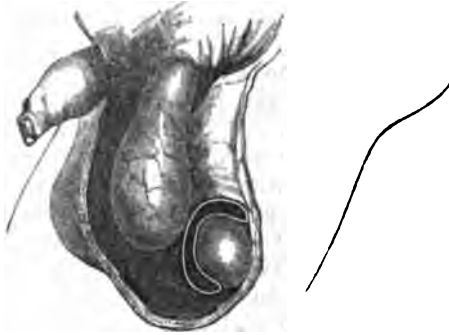
III. CONGENITAL INGUINAL HERNIA.

Congenital inguinal hernia—more properly called hernia into the tunica vaginalis, because while it is usually congenital, or met with in young infants, it sometimes, though rarely, presents itself at a more advanced age—differs from the two species already described, in that

Fig. 160. From Liston.

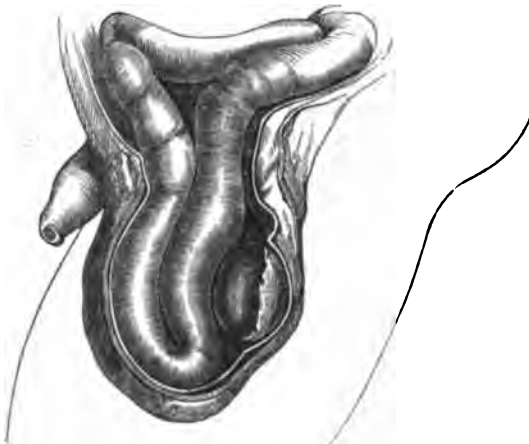
they, if they descend into the scrotum, are without, as is shown in the accompanying delineation, but this is contained within the tunica vaginalis. The two accompanying diagrams, though somewhat altered and improved, taken from the works of a writer who was once a great ornament of

Fig. 161.



the surgical profession, shows the opposite relations of common and congenital inguinal hernia to the tunica vaginalis. The manner in which this species of hernia is formed, may be thus explained. Although the tubular portion of peritoneum, which, for a short time after the descent of the testicle, forms a canal of communication between the tunica vaginalis within the scrotum and the peritoneum within the abdomen, usually becomes very soon occluded, and ultimately quite

Fig. 162.



obliterated, so that the cavity of the tunica vaginalis is perfectly separated from that of the abdomen, yet in some cases the tubular por-

Fig. 161. A scrotal hernia; showing the usual relation of the sac to the tunica vaginalis.

Fig. 162. Congenital scrotal hernia; showing the situation of the hernia within the tunica vaginalis.

tion does not exhibit its usual disposition to close and become obliterated, and while this state continues, on crying or making some exertion, a portion of intestine may be sent down through the tubular canal into the cavity of the tunica vaginalis, and thus constitute what is called a congenital hernia. As it is only after the inflation of the lungs that the usual exciting causes are applied, this variety rarely occurs till after birth; but sometimes a portion of intestine in contact with the testicle while within the abdomen, adheres to the testicle, and descends with it into the scrotum at the usual time at which the gland leaves the abdomen, and in such cases constitutes the hernia prior to birth. Congenital hernia is almost invariably formed of intestine alone; the omentum very rarely descending so far as the commencement of the tubular canal. The principal peculiarities distinguishing this from the two former species are, that it has no hernial sac of peritoneum proper to itself, the tunica vaginalis being its immediate investment and forming its hernial sac; that it is in contact with the testicle, which consequently cannot be so distinctly felt as in the more common species; that the whole swelling is more uniform and firm than in an oblique or direct inguinal hernia, and that the different parts are less easily felt and distinguished. Most of these peculiarities depend on that previously mentioned, namely, its being within the tunica vaginalis, which is thicker and firmer than the peritoneum, which forms the sac in the more common varieties. The descent of this species is usually sudden and complete.

For this variety in its different states of reducible, irreducible, and strangulated, the same rules are to be followed as have been already laid down for the treatment of hernia in general. When it is found in adults, and becomes strangulated and requires an operation, the seat of stricture is almost invariably higher up than the external aperture, and the operation is more difficult than in oblique or direct hernia, from the parts being concealed and the parietes being thickened. The incision should not be carried further down than to within about three inches of the under part of the tunica vaginalis, because as that membrane has to be opened, if the incision were carried lower, the testicle would be unnecessarily exposed to irritation. In other respects the operation is the same as for oblique inguinal hernia.

IV. ENCYSTED CONGENITAL INGUINAL HERNIA.

This variety, which is still more rare than the former, has been more properly termed encysted hernia of the tunica vaginalis; for though, like the last species, it is within, yet it is not in contact with the tunica vaginalis, but is separated from it by a hernial sac. That the hernia is within the tunica vaginalis, and that it is contained within a hernial sac, there is no doubt. There has indeed been some difference of opinion as to the mode of formation of the sac, but it now seems nearly certain from various dissections that it is formed in one or other of the two following ways. If the tunica vaginalis remain open in every way except at the abdominal canal, and if imperfect adhesions form at that point, and a hernia descend into the part above the adhesions, the adhesions becoming elongated and pushed down before the hernia constitute

the hernial sac—the sac proceeding from, and adhering firmly to the tubular portion of membrane between the abdomen and the tunica vaginalis. Or, if the tunica vaginalis remain open everywhere except at one part, and be there imperfectly closed, the peritoneum being pressed down before the hernia into the tunica vaginalis will thus constitute a *serous* covering for the hernia.

V. HERNIA INFANTILIS.

This term is applied to a very rare species of hernia, originating in early life, which may be said to consist of a hernia with the usual peritoneal sac placed behind the tunica vaginalis. The way in which it takes place may be thus explained. The cavity of the tunica vaginalis is unusually large, contains some serous fluid, and ascends high up in the cord, although its communication with the abdomen is occluded. The hernia, with the usual peritoneal sac, is sent down behind the tunica vaginalis, and in consequence, three layers of serous membrane, namely, the front and back of the tunica vaginalis, and the front of the hernial sac, must be cut through before arriving at the substance of the hernia.

II. FEMORAL HERNIA.

A hernia is called *femoral* or *crural* when the descent takes place behind Poupart's ligament, through what is termed the femoral or crural ring; which ring being much larger in the female than in the male, from the space being greater between the anterior superior process of the ilium and the pubes, femoral hernia, which is in the male a very rare occurrence, is comparatively frequent in the female. The nomenclature adopted in the following description, is that employed by some of our best writers on anatomy, who call the space in which a femoral hernia is situated, the femoral or crural canal, its upper extremity the femoral ring or abdominal extremity, and the other the saphenous opening or femoral extremity of the femoral canal.

[“The muscles of the abdomen, beneath the edge of which the femoral hernia escapes, are represented by the aponeurotic band of the external oblique muscle, which is commonly known as Poupart's ligament, but which, in connexion with the femoral hernia, is named the *femoral* or *crural arch*. Extending from the anterior superior spine of the ilium to the pubes, this band widens at its inner end, and, inclining or folding backwards, is fixed to a part of the pectineal line, as well as to the spine of the pubic bone. The small triangular portion attached to the pectineal line is known as Gimbernat's ligament (Hey). The outer edge of this part is concave and sharp; with other struc-

Fig. 163.



Fig. 163. The innominate bone of the left side with, 1. The femoral or crural arch; 2. Gimbernat's ligament.

tures, to be presently described, it forms the inner boundary of the aperture through which the hernia descends. The breadth and strength of Gimbernat's ligament vary in different bodies, and with its breadth varies the size of the opening which receives the hernia.

"The space comprised between the femoral arch and the excavated margin of the pelvis is occupied by the conjoined psoas and iliacus, with the anterior crural nerve between those muscles and the external iliac artery and vein at their inner side. Upon these structures the fascia which lines the abdomen is so arranged as to close the cavity against the escape of any part of the viscera, except at the inner side of the blood-vessels. But the arrangement of the parts situated thus deeply (towards the cavity of the abdomen) will be most conveniently entered upon after those nearer to the surface shall have been examined. To this examination we now proceed.

"The general disposition of the *superficial fascia* met with on removing the common integument from the groin has been described. In connexion with the present subject, it will be enough to mention the following facts. The deeper layer of this structure adheres closely to the edge of the saphenous opening, and the careful removal of it is necessary in order adequately to display that aperture. Where it masks the saphenous opening, the deep layer of the superficial fascia supports some lymphatic glands, the efferent vessels of which pass through it; and the small portion of the membrane so perforated is named the *cribriform fascia*. The superficial and the deep fasciæ adhere together along the fold of the groin likewise, and this connexion between the two membranes serves the purpose, at least, of drawing the integument the more evenly into the fold of the groin, when the limb is bent at the hip-joint.

"By Scarpa the deep layer of the superficial fascia which covers the abdomen was described as an emanation from the fascia lata, extended upwards over the external oblique muscle.¹ But different modes of viewing the continuity of such structures depend very much on the manner of conducting the dissection. In the present case, for example, the fascia may be said to proceed from above or from below, according as the parts are dissected from the abdomen downwards or from the thigh upwards. Such difference, however, is no more than a verbal one, the material fact being merely that the two membranes are connected together along the groin.

"The separation of the *fascia lata* into two parts at the saphenous opening, and the positions and connexions of each part, having been described in detail, only a few points in the arrangement of this membrane will be noticed in this place. At the lower end of the saphenous opening the iliac division of the fascia is continuous with the pubic by a well-defined curved margin immediately above which the saphenous vein ends; above the opening a pointed cornu (falciform process—Burns²) of

¹ A Treatise on Hernia, translated by Wishart, p. 247.

² Edinb. Med. and Surg. Journal, vol. ii. p. 263, and fig. 2.

In the first edition of Hey's Practical Observations in Surgery, the upper end of this process of the fascia was named the "femoral ligament;" and since then several anatomists have distinguished the same part as "Hey's ligament." But Mr. Hey dropped the designation in the subsequent editions of the same work, and there seems no good reason for continuing it. Compare the original edition (1803), p. 151, and plate 4, with the third edition (1814), p. 147, and plates 4, 5, and 6.

the same portion of the fascia extending inwards in connexion with the femoral arch reaches Gimbernat's ligament; and in the interval between the two points now referred to (*i. e.*, from the upper to the lower end of the saphenous opening), the iliac layer of the fascia lata blends with the subjacent sheath of the femoral vessels as well as with the superficial fascia. The pubic part of the fascia covers the pectineus muscle, and is attached to the pectineal ridge of the pubes. Immediately below the femoral arch the iliac and pubic portions lie one before, the other behind the femoral blood-vessels and the sheath of these. They occupy the same position with respect to the femoral hernia.

"The anterior or iliac part of the fascia lata being turned aside the *sheath of the femoral vessels* will be in view (Fig. 152). The sheath is divided by septa, so that each vessel is lodged in a separate compartment, and the vein is separated by a thin partition from the artery on one side and from the short canal for the lymphatics on the other side.

Fig. 164.



Fig. 165.



Along the thigh the sheath is filled by the artery and vein, but behind the femoral arch it is widened at the inner side. Here it is perforated

Fig. 164. The femoral vessels of the left side, with their sheath laid open, and a small hernia displayed.—1. The lower part of the external oblique muscle. 2. The anterior superior spine of the ilium. 3. Iliacus muscle. 4. Sartorius. 5. Pubic part of the fascia lata. 6. Femoral artery. 7. Femoral vein. 8. A small hernia.

Fig. 165. The groin of the right side dissected so as to display the deep femoral arch.—1. The outer part of the femoral arch. 1'. Part of the tendon of the external oblique muscle, including the femoral arch, and also the inner column of the external inguinal ring, projecting through which is seen a portion of the spermatic cord cut. 2. The femoral arch at its insertion into the spine of the pubes. The fibres outside the nomenclature are those of Gimbernat's ligament. 3. The outer part of the femoral sheath. 4. The spermatic cord, after having perforated the fascia transversalis. 5. The deep femoral arch—its inner end where it is fixed to the pubes. 6. Internal oblique muscle. 7. Transversalis. Beneath the lower edge of this muscle is seen the transversalis fascia, which continues into the femoral sheath under the deep femoral arch. 8. Conjoined tendons of the internal oblique and transversalis muscles. 9. A band of tendinous fibres directed upwards behind the external abdominal ring.

for lymphatic vessels, and on this account is said to be 'cribriform.'¹ This inner, wider part of the sheath it is that receives the femoral hernia; and in connexion with the anatomical description of that disease it is designated the femoral canal. At its upper end the sheath of the vessels is continuous with the lining membrane of the abdomen—with the fascia transversalis at its fore part, with the fascia iliaca behind.

"When the femoral arch is being removed it will be found that a bundle of fibres, springing from its under surface outside the femoral vessels, extends across the fore part of the femoral sheath, and, widening at its inner end, is fixed to the pecten of the pubes behind Gimbernat's ligament. This tendinous band is known as the *deep femoral arch*. Connected with the same part of the pubes is the conjoined tendon of the internal oblique and transversalis muscles. The tendon lies behind the attachment of the deep femoral arch. In many cases the last-named structure is not strongly marked; and it may be found to blend with the tendon of the muscles just referred to. Not unfrequently it is altogether wanting.

"Attention being now directed to the internal surface of the abdomen:—When the peritonæum has been removed, it will be observed that the fasciæ lining the cavity form, for the most part, a barrier against the occurrence of hernia; for outside the iliac vessels the fascia iliaca and fascia transversalis are continuous one with the other behind the femoral arch. These fasciæ are, in fact, but parts of the same membrane to which different names are assigned for the convenience of description, just as distinctive names are applied to portions of the same artery. But where the iliac artery and vein occur the arrangement of the fasciæ is different. The vessels rest upon the fascia iliaca; and the membranes, instead of joining at an angle as elsewhere, are continued into their sheath in the manner above described.²

"The sheath is closely applied to the artery and vein, so that, in the natural or healthy state of the parts there is no space left for the formation of a hernia in the compartments which belong to those vessels; but at the inner side of the blood-vessels will be found a depression which is occupied but partially with the lymphatics. This is the femoral ring, the orifice of the femoral canal.

"*Femoral ring*.—After the removal of the peritonæum, this opening is not at first distinctly discernible, being covered with the laminated cellular membrane (subserous) which intervenes between the peritonæum and the walls of the abdomen. That part of the membrane which covers the ring was found by M. Cloquet to possess in some cases considerable density; and, from being the only barrier in this situation between the abdomen and the top of the thigh, it was named by that observer the *cru-*

¹ The word "cribriform" being applied to this part as well as to the layer of the superficial fascia stretched across the saphenous opening, the two structures are distinguished in the following manner:—the former is known as the cribriform portion of the sheath of the vessels, while to the latter is assigned the name of cribriform fascia.

² Some anatomists describe the sheath of the vessels as continued down from the membranes in the abdomen, while others regard it as an emanation from the fascia of the thigh, but continuous with the abdominal fasciæ. As this difference in the manner of viewing the structure in question does not alter the facts in any way, it is quite immaterial which of the modes of description is adopted. But it appears to me most natural to regard the sheath as a production of the fascia lata.

ral septum (septum crurale). But this structure is usually no more than loose cellular membrane, and it forms but a very slight partition. On clearing it away the ring is displayed. It is a narrow opening, usually of sufficient size to admit the end of the fore-finger; the size, however, varies in different cases, and it may be said to increase as the breadth of Gimbernat's ligament diminishes, and the converse. It is larger in the female than in the male body. On three sides the ring is bounded by very unyielding structures. In front are the femoral arches; behind is the horizontal branch of the pubes covered by the pectineus muscle and the pubic layer of the fascia lata; on the outer side lies the external iliac vein, but covered with its sheath; and on the inner side are several layers of fibrous structure connected with the pectineal line of the pubes—namely, Gimbernat's ligament, the deep femoral arch, and the conjoined tendon of the two deeper abdominal muscles with the fascia transversalis. The last-mentioned structures—those bounding the ring at the inner side—present respectively a more or less sharp margin towards the opening.

“*Femoral canal*.—From the femoral ring, which is its orifice, the canal continues downwards behind the iliac part of the fascia lata (its falciform process), in front of the pubic portion of the same membrane, and ends at the saphenous opening. It is about half an inch in length; but in its length the canal varies a little in different cases.

“*Blood-vessels*.—Besides the femoral vein, the position of which has been already stated, the epigastric artery is closely connected with the ring, lying above its outer side. It not unfrequently happens that the obturator artery descends into the pelvis at the outer side of the same opening, or immediately behind it; and in some rare cases that vessel turns round the ring to its inner side. Moreover, an obturator vein occasionally has the same course; and small branches of the epigastric artery will be generally found ramifying on the posterior aspect of Gimbernat's ligament. In the male body, the spermatic vessels are separated from the canal only by the femoral arch.

“To the foregoing account of the anatomical arrangement of the parts concerned in femoral hernia, may be added certain measurements, showing the distance of some of the most important from a given point. They are copied from the work of Sir A. Cooper:—¹

	MALE.	FEMALE.
From the Symphysis pubis to the anterior spine of the ilium, .	5½ inches.	6 inches
From same point to the middle of the iliac vein, .	2½ “	2½ “
“ “ to the origin of the epigastric artery, .	8 “	8½ “
“ “ to the middle of the lunated edge of the } fascia lata, .	8½ “	2½ “
“ “ to the middle of the femoral ring, .	2½ “	2½ “

The preceding description of the parts is copied from Quain and Sharpey's Anatomy.—ED.]

Direction.—A femoral hernia may be said to have three peculiarities of direction, namely, at first, and while within the femoral canal, downwards; on arriving at the saphenous aperture, forwards; and afterwards obliquely upwards and inwards; thus describing an arch, the convexity

¹ On Crural Hernia, p. 5.

of which is downwards, and in a measure embracing three of the four aspects of Poupart's ligament—namely, the posterior, femoral, and anterior; the neck of the hernia being behind the ligament, the body on its femoral aspect, although removed a very little from it, and its fundus in front. These peculiarities suggest the necessity of straightening the

Fig. 166.



hernia, or of bringing down its fundus, before efforts are made to return it by the taxis. The first change of direction is caused by the narrowing of the sheath, and its close adhesion to the vessels, together with the close adhesion of the iliac portion of the fascia lata to the front, and of the pubic portion of the same membrane to the back of the sheath at the under extremity of the femoral canal—conditions which, by producing constriction, offer an obstacle to further descent in a perpendicular direction; whereas there is little to impede the passage forward through the saphenous aperture. The second change of direction is caused partly by the firm adhesion of the fascia superficialis to the front of the fascia lata, but chiefly by the pressure against the superficial epigastric vessels, by which the forward progress of the hernia is opposed, whereas they offer no obstacle to its passing upwards in front of Poupart's ligament.

Coverings.—The fascial coverings from within outwards are, First, the hernial sac, formed of peritoneum. Second, the sub-peritoneal cellular tissue which lines the femoral ring, or abdominal extremity of the femoral canal. This substance, called by some authors the septum crurale, is pressed down before the hernial sac, and, together with the

Fig. 166. Drawing showing certain parts concerned in femoral and inguinal hernia.





aggregate of textures, which in the normal condition occupy the femoral canal, constitutes the second covering. This covering is by some named the fascia propria,—a term applied by others to the third covering, consisting of the fascia infundibuliformis, or sheath of the femoral vessels, within which the hernia descends. The two last-mentioned coverings are, in many instances, so matted together as to form but one. Fourth, the layer of cellular tissue which spreads over the saphenous opening, and which is perforated by various vessels. This is by some called the cribriform fascia, and considered (I think, properly) as the deep layer of the superficial fascia; whereas it is described by others as the middle division of the fascia lata. Fifth, the superficial fascia with some absorbent glands and adipose tissue; and, Sixth, the common integument. There are great varieties with regard to the thickness of the coverings, and it is supposed that in some instances the hernia escapes through some of the openings in the femoral sheath and in the cribriform fascia, in which cases there will seem to be only two coverings interposed between the common integument and the hernial sac. I have been much struck, in my own operations, with the great difference in different cases of the thickness of the fascial coverings, and with the fact, that instead of six different membranes, constituting so many distinct coverings, as is the case in inguinal hernia, and as we might expect from contemplating the anatomy of the parts in the normal state, there are sometimes found only three; namely, the hernial sac; a cellulo-adipose layer, which varies much in thickness in different cases; and the skin. The greatest number, however, of fascial coverings which can present themselves, are the six enumerated above.

Anatomical relations of the Neck of the Hernial Sac.—The neck of a femoral hernia is related to the boundaries of the femoral ring as follows, namely, posteriorly, to the fascia iliaca, where it covers the linea ilia pectinea; anteriorly, to Poupart's ligament, lined by the prolongation downwards of the fascia transversalis; internally, to the base of Gimbernat's ligament, at the junction of the fascia iliaca and fascia transversalis; and externally to the femoral vein, from which it is separated only by the interposition of a membranous slip. There is also another relation which sometimes exists, namely, to the obturator artery, when that vessel, instead of coming off from the internal iliac, arises from the external iliac by a common trunk with the internal epigastric. When it has that irregular origin, the obturator artery crosses the femoral ring as it dips into the pelvis on its way to the obturator foramen, occasionally passing near to the posterior and iliac sides of the femoral ring, but much more frequently in front and towards the pubic side. In the latter case, if a hernia be present, the artery will embrace about two-thirds of the circumference of the abdominal aspect of the neck of the hernial sac, namely, the front and inner aspect; so that when the stricture is found at the femoral ring, great caution should be used not to make too extensive a division, or to send up the cutting edge of the instrument farther than is indispensable for dividing the tissue which constitutes the stricture.

Seats of Stricture.—This is a subject on which much attention has been bestowed; and although in some points a difference of opinion

exists, it is certain, from the testimonies of high surgical authorities, that the stricture may be at the femoral ring, the textures constituting the ring forming the stricture; or at the saphenous extremity of the canal, and formed by the crescentic border of the fascia lata; or at the neck of the sac, and formed either by the sac itself, or by thickened textures around. In my own operations, I have invariably found the stricture at the femoral ring, and the majority of authors agree, that it is found there more frequently than elsewhere; but it is certain that it is sometimes found in the other situations mentioned. In some instances, a stricture has been found at more than one of the above sites at the same time. Such are the usual seats of stricture, and the constituting textures in this species of hernia; but in some rare instances strangulation has been found to be occasioned by a loop of intestine, by a band of omentum, or (which is an extremely rare occurrence) by the circumference of an unusual opening in Gimbernat's ligament.

Operation.—The body having been properly placed, the first step of the operation consists in making the integumental incision, various forms of which have been adopted, some making a simple incision which is not the most convenient; some a crucial, which is objected to, as the under part of the vertical portion might interfere with the vena saphena major; some an incision, composed of two parts, the one oblique and in the course of Poupart's ligament, the other extending down from the former in a vertical direction, so that the incision is

formed thus , on the right side, and thus , on the left; others making an incision thus , and others adopting the same form inverted, thus . The last-mentioned form is convenient, and may

be made without risk of wounding important parts underneath, by transfixing the skin after pinching it up, the vertical portion extending from about an inch and a half above the crural arch, in a line with the centre of the tumour; and being met below by the transverse portion, which should go from one side of the tumour to the other, parallel to Poupart's ligament, but a little below it. The next step is to cut through the various coverings, and lay open the hernial sac. This having been done, and the fore-finger of the left hand introduced within the sac, and carried up in front of the hernia, and the seat of the stricture ascertained, the hernial knife, with its blunt point, should be carried up flat upon the finger, until its point be within the stricture, when its edge should be directed against the stricture, and the necessary division effected, by cutting directly forwards. Great care should be taken not to lacerate the intestine by the introduction of the finger, or to allow it to come against the edge of the knife, or to admit the knife farther than is absolutely necessary for the division of the stricture, lest the unusual disposition above mentioned of the internal epigastric artery should exist, and the edge of the knife should reach the artery.

The remaining parts of the proceeding should be regulated by the principles laid down in the description of the operation in general.

By the above proceeding, the operation may be accomplished with as little difficulty and risk, as by any other; but it may be proper to add, that, as regards the direction in which the stricture is divided, the modes adopted are very various. If the stricture be at the saphenous opening, there is no particular danger to guard against, and the surgeon may, in dividing the stricture, cut upwards and inwards, directly upwards, or upwards and outwards, and the operation is comparatively easy; and when it is at the femoral ring, the knife may be safely carried to a small extent inwards, into Gimbernat's ligament, upwards and inwards, directly upwards into Poupart's ligament, or upwards and outwards; but not directly outwards, on account of the femoral vein. The cutting inwards into Gimbernat's ligament has been recommended by Manchart, Richter, Gimbernat, Boyer, Roux, Hey, Lawrence, and Ferguson, and others have objected to it, because it is more difficult, from the greater depth, to cut into Gimbernat's, than into Poupart's ligament; because there is, from the same reason, greater danger of cutting or tearing the intestine when endeavouring to get at the seat of the stricture, and also because so little additional room would be gained by the division of Gimbernat's ligament. The cutting upwards and inwards, recommended by Heister, Le Dran, Sabatier, Lassus, Chopart, Desault, and others, has been objected to on the ground, that if the hernia be in the male (which, however, is a comparatively rare occurrence), the knife is carried in the direction of the spermatic cord: but this danger seems to have been greatly exaggerated; for the knife ought never to be carried so high as to endanger the cord in the male, or the round ligament of the uterus in the female. The direction of the incision adopted by Pott, Sir Astley Cooper, and many others, was directly forwards, that by Mr. Liston forwards and a little inwards. Sharp cut upwards and outwards; and so did Dupuytren, but a very different proceeding; he carried the knife from within outwards, and from below upwards; and although in this method, the edge of the instrument is no doubt carried in the direction in which the epigastric artery is found, there is no danger of the artery being wounded, as the knife is not carried so high as to be in danger of reaching it. Scarpa had recourse to multiple incision in the under border of the crural arch.

III. UMBILICAL HERNIA.

The cases of umbilical hernia have been variously arranged by various writers. Scarpa divides them into two classes, namely—the congenital, appearing in the infant at birth, and the adventitious, occurring at any after period: but a more convenient arrangement is that of Mr. Lawrence, who gives three varieties, namely—the congenital, which appears at birth; the hernia of children, which appears after the navel has been formed; and the umbilical hernia of adults.

CONGENITAL UMBILICAL HERNIA.

The congenital variety is occasioned by an original deficiency in the formation of the umbilicus; it exists at the period of birth, and is therefore properly called congenital; it forms a tumour, conical in

form, the contents of which are for the most part intestine sent into the cord between its vessels, the umbilical vein being usually above and the arteries below, or on either side. The external covering of the tumour near the base is composed of integument, but at a farther distance it is formed by an expansion of the substance of the cord, for the hernia is sent through the umbilicus into the cord. The cavity is lined by a small peritoneal covering.

The treatment consists in returning the hernia, and preventing a recurrence of the protrusion;—two points of the utmost importance to attain, as in the event of the hernia not being reduced, the separation which must ensue of the expanded portion of the cord which forms part of the coverings, would expose the patient's life to the greatest danger. The method usually adopted in this country to prevent reprotrusion, is compression by means of compresses and a bandage. Another plan, to which reference will be made in the next section, is to use the ligature with compression.

THE UMBILICAL HERNIA OF CHILDREN.

In this, which is a very common species of umbilical hernia, the object of treatment is, to return the protruded parts, and to keep them in that condition until the contraction and subsequent obliteration of the umbilical ring prevents any future reprotrusion. The means adopted for this purpose is compression, or the ligature; the former is attended with less pain and risk, and has always been preferred by the great majority of British practitioners. Various modes have been employed for producing the requisite compression. A very convenient method is by a piece of cork covered with soft leather, and kept in the umbilicus by strips of adhesive plaster, the whole being retained by means of soap plaster spread on the leather, and applied in a transverse direction. Another method is, to apply the half of an ivory ball to the umbilicus, retaining it by adhesive plaster, and a bandage, or some other appliance for the same purpose.

The treatment by ligature was practised by Desault and Dupuytren, and their example has been followed by some others. An able and successful member of the surgical profession has given the following account of it:—"The infant being laid on its back, and its head bent on its chest, and its thighs flexed on its pelvis, the surgeon reduces the hernia, retains it with his left forefinger, and with his right hand raising the parietes of the hernial pouch, he slides them between his fingers to make sure that no part remains in the sac. Being assured of this, his assistant makes several turns round the sac, at its base, with a waxed thread, each turn being well tightened and secured by a double knot. The tumour thus tied is enveloped in a bed of lint, maintained by a compress and bandage. On from the eighth to the tenth day the ligature falls off with the parts it has strangled and killed. A small ulcer results, which is soon healed. It is well for the child to wear a bandage for two or three months, the better to prevent a relapse." This mode of cure, however, has not gained the favourable opinions of the surgical authorities in this country.

Various cases are recorded by Desault, and some are mentioned by Soemmerring and others, in which spontaneous cures occurred from the

natural tendency of the umbilicus, in early life, to close; but such occurrences are so rare that the surgeon is not warranted in leaving cases to the unassisted efforts of nature.

UMBILICAL HERNIA IN ADULTS.

This is rarely met with in males, but more frequently in females. Pregnancy is one of its most usual exciting causes; hence its comparative frequency in females who have borne many children. In almost all cases of umbilical hernia in adults, omentum forms some part of the hernia, and to this has been attributed the fact that in the greater number of instances in which strangulation occurs, the symptoms are less urgent than in most other species of hernia. An umbilical hernia may be reducible, irreducible, or strangulated; and in each of these conditions the treatment should be conducted according to the principles laid down in the general doctrines of hernia. The coverings are very thin, consisting merely of the cicatrix of the navel, the hernial sac formed of peritoneum, and the very thin layer of cellular tissue by which they are connected together. In performing the operation, it should be remembered that these coverings are often exceedingly thin, and that although every umbilical hernia has originally a peritoneal sac, yet when the hernia is large, the sac becomes so thin by dilatation, or absorption, or both, as scarcely to be perceptible. When the peritoneum becomes exceedingly thin and adherent to the skin, the covering is often found to present the appearance of being formed of only one layer. The coverings may be divided by a longitudinal or any convenient form of incision, and the stricture may be divided by cutting upwards and to the left side.

IV. VENTRAL HERNIA.

By a ventral hernia is understood one through any part of the front of the abdomen, except the inguinal canal, the femoral canal, or the umbilicus. Cases belonging to this class should be treated according to the general principles already laid down.

Such are the various classes into which herniæ in accessible situations are divided. Occasionally, however, they are found in inaccessible situations,—for example, in the diaphragm, the obturator foramen, or the greater ischiatic notch; constituting diaphragmatic obturator, or ischiatic hernia. Sometimes cases occur of a mixed class; for example, a perineal hernia, which consists of a descent between the bladder and the rectum, the swelling presenting itself in the perineum; or a vaginal hernia, in which the tumour projects into the vagina. Examples of hernia in inaccessible situations are, happily, of rare occurrence; they cannot be made the subject of surgical treatment; and their existence only becomes a matter of certainty after death.

I shall conclude this section on hernia with the following remarkable case of strangulation, caused by a diverticulum. I recorded the case in the number of the "Edinburgh Monthly Journal of Medical Science," for July, 1849:

David White, seventeen years of age, a fine-looking young man, had always enjoyed excellent health until the 22d of April; on which day,

while walking in the street, he was suddenly seized with sickness, vomiting, and violent pain in the abdomen; the pain being constant, but attended with frequent paroxysms of aggravation.

At the commencement of the attack the belly was not tumid, nor was there any tenderness on pressure—on the contrary, the patient had an inclination to compress the belly with his hands, especially during the paroxysms of pain, and to turn himself round in bed. In the course of five or six hours, however, the abdomen became tender to the touch, and ultimately so much so that the slightest touch occasioned pain and vomiting; the belly gradually became tumid; and the patient was obliged to preserve his body as motionless as possible in order to prevent the aggravation of pain.

Such is the history of the symptoms, as given by my friend, Dr. George Morrison, who attended him from the commencement of the attack.

My colleague, Professor M'Robin, and I saw the patient for the first time twenty-four hours previous to his death. His symptoms, when we saw him, were—distension of the abdomen; constant violent pain, with paroxysms of aggravation like the tormina of ileus; tenderness on pressure; sickness, urgent vomiting of a greenish liquid; no stool after the commencement of the attack; pulse one hundred and thirty, small and feeble; features collapsed, and the countenance expressive of great exhaustion.

These symptoms continued for twenty-four hours, without undergoing any material change, death taking place within sixty hours from the commencement of the attack.

The suddenness with which the symptoms appeared, their history, and the absence of swelling in any of the usual sites of hernia, produced a strong impression on the mind of Dr. Morrison, Professor M'Robin, and myself, that the symptoms were caused either by intussusception, or by internal hernia, or by some internal cause of strangulation; in short, that it was a case of enteritis, occasioned by some internal mechanical cause.

I made a post-mortem examination twenty-four hours after death, in presence of the medical gentlemen above mentioned. On opening the abdomen, a small quantity of sero-sanguineous fluid was found in the cavity of the peritoneum; the stomach, and a great part of the small intestine, were greatly distended with flatus; the distended portion of the intestine was much inflamed, and there were slight adhesions of lymph in some parts. The lower third of the ilium and the whole of the great intestine were collapsed, and of a perfectly healthy appearance. On displacing some of the convolutions of the small intestine, a portion of the ilium, twelve inches in length, was found greatly distended, strangulated, and in a state approaching to gangrene; the part of the intestine to the gastric extremity of the strangulated portion being violently distended and inflamed, and that to the rectal extremity being comparatively collapsed, and of a perfectly healthy appearance; the strangulation being effected by a diverticulum of the ilium, having very peculiar relations and connexions.

Fig. 167 of the accompanying drawings gives a front view of the

strangulated intestine and stricture. Fig. 168 gives a posterior view. Fig. 169 presents an appearance of the natural relations of the *diverticulum*, obtained after emptying the intestine, and withdrawing it from underneath the diverticulum by which it was strangulated.

The diverticulum was an inch and a-half in length, and terminated in a slightly-dilated cul-de-sac; from the extremity of which a membranous band was sent off, one extremity of which was evidently continuous with the serous coat of the diverticulum, and the other as evidently not merely attached to, but becoming continuous with, the anterior lamella of the mesentery. Through the aperture formed by the diverticulum, mesentery, and the portion of the intestine, from which the diverticulum

Fig. 167.



Fig. 168.



is continued, twelve inches of intestine had passed at the commencement of the attack, and became strangulated.

The above cannot but be regarded as a very curious and extremely unusual case—not that it is rendered so by the mere existence of a diverticulum, which is itself a rare formation, but the presence of a diverticulum being the occasion of strangulation.

There is on record one case bearing a striking resemblance to the above. I allude to a preparation in the museum of St. Bartholomew's Hospital, of which I subjoin the description as extracted from the published catalogue of that valuable collection:—

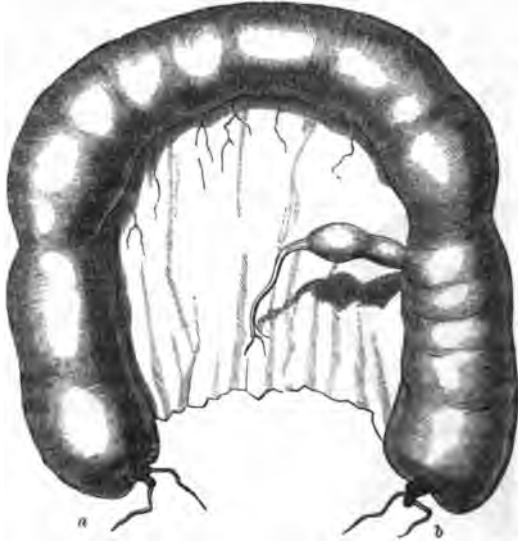
“Portion of small intestine, from which a diverticulum is continued.—The extremity of the diverticulum is adherent to the contiguous part of

Fig. 167. Anterior view of the strangulated intestine and stricture;—a, gastric extremity; b, rectal extremity.

Fig. 168. Posterior view of the strangulated intestine and stricture;—a, gastric extremity; b, rectal extremity.

the mesentery, so as to form a circular aperture or ring. Through this aperture a portion of intestine, twelve inches long, passed, and became strangulated. The patient, a lad subject to constipation, died four days after signs of strangulation of the intestine."

Fig. 169.



It will, however, be seen that, in one point at least, the cases differ: in that of St. Bartholomew's Museum, the fundus of the diverticulum is adherent to the contiguous portion of the mesentery—whereas, in the case I have described above the fundus of the diverticulum is connected with the mesentery by the serous coat becoming contracted into a membranous band, and expanding into the anterior lamella of the mesentery. In the catalogue of the museum of the Royal College of Surgeons in Ireland, there is a description of a preparation in which a diverticulum, four or five inches long, caused strangulation of several feet of intestine; but the relations of the diverticulum, as well as the mode in which it effected strangulation, were very different from the case described above.

Fig. 169. An appearance of the natural relations of the diverticulum to the intestine: *a*, gastric extremity; *b*, rectal extremity.

CHAPTER XIV.

WOUNDS OF THE ABDOMEN.

ALTHOUGH the doctrines respecting the treatment of wounds generally is applicable to wounds of the abdomen, yet as these are particularly dangerous and require certain peculiarities of treatment, it is necessary to give a fuller account of the different sources of danger and of the treatment required in wounds of various kinds in that part of the body. There have been instances in which both the fixed and the floating viscera have been wounded, in which balls and sharp instruments have passed through the body, and yet the patient has recovered ; but still when wounds of the abdomen are accompanied by injury of the contained viscera, they are extremely dangerous, and in the majority of instances fatal. The chief sources of danger are *hemorrhage, fatal depression of the nervous system, extravasation of visceral contents, and peritonitis.*

Hemorrhage may prove fatal, either very speedily from the loss of blood, as when any large vessel in the abdomen is wounded, or when there is an extensive deep wound of such organs as the liver or spleen—such cases presenting the usual symptoms attendant on profuse internal hemorrhage ; or when the loss of blood is not of sufficient extent to produce death, by its occasioning inflammation of the peritoneum, which quickly leads to the most unfavourable results.

Depression of the nervous system, although generally attendant in a greater or less degree on wounds of the abdomen as well as on blows on that part, more rarely occurs to a fatal extent in the former than in the latter case ; yet sometimes it terminates in death, the sudden shock given to the nervous system causing the failure of the heart's action,—a result which has been supposed by some to occur more frequently after wounds of the stomach and duodenum than of the other viscera.

Extravasation of visceral contents does not occur so often as might be expected ; indeed, it is astonishing how seldom such effusion takes place in cases of a small wound of the intestine ; extravasation being in such cases prevented, in the first instance, by the constant equable pressure which the abdominal viscera exert on each other, the various surfaces being constantly in close contact, and by the tendency to protrusion of the mucous membrane, which plugs up the orifice, and afterwards by exudation of coagulable lymph on the exterior of the wound, by which and by adhesion to surrounding textures the breach becomes permanently repaired. By this process both hemorrhage and extravasation of intestinal contents are often prevented ; but if the viscus be full, or the wound very considerable, effusion of visceral contents into the sac of the

peritoneum is very apt to take place ; and if so, the result is certain to be fatal—for escape of bile, or of urine, from the great acrimony of these secretions, or of the contents of the alimentary canal, will produce the greatest possible suffering, which very speedily terminates in death. The most prominent symptoms in such cases are—sudden, unremitting, and excruciating pain, great prostration of strength, ghastly anxiety of countenance, extremely feeble pulse, and on the part of the patient, a decided conviction of approaching death.

Peritonitis is another source of danger, and one so common that it may be said to be the cause of death in almost all fatal cases of penetrating wounds of the abdomen, excepting those in which death takes place from the great and sudden loss of blood, or from the shock given to the nervous system, or from extravasation of visceral contents, in which death occurs so soon after the extravasation, and so little trace of inflammation is discernible, that it appears most probable that the fatal result was occasioned by the sinking of the nervous system.

For the clearer explanation of the principles to be followed in the management of wounds of the abdomen, it is convenient to arrange them into four classes—1st. Wounds which simply penetrate the cavity without injuring any of its contents ;—2dly. Wounds which not only penetrate the cavity, but injure some of the contained viscera, without protrusion of the wounded part ;—3dly. Wounds attended with protrusion without any wound of the protruded part ; and, 4thly. Wounds accompanied not only with protrusion, but also with injury of the protruded part.

1st. Wounds which simply penetrate into the abdominal cavity are the least dangerous ; yet if the wound be extensive there is risk of its giving rise to peritoneal inflammation. The great object of treatment, therefore, is to guard against this occurrence, for which purpose absolute rest and the sparing use of the mildest ingesta should be strictly enjoined, together with the best local treatment for procuring adhesion,—comprehending attention to position, the use of adhesive plaster for keeping the edges of the wound in apposition, and if necessary, the interrupted suture. Sutures should not be employed unless absolutely necessary ; and when their use is ventured upon, special care is to be taken not to include the peritoneum in the suture. All judicious and available means should be employed to prevent inflammation, and if it should occur, appropriate remedies should be used to subdue it, such as low diet, perfect quiet and rest, venesection, calomel and opium, fomentations, mild enemata, and if it can be conveniently employed, the warm bath.

2dly. Wounds which not only penetrate the cavity, but also injure some of the contained organs without protrusion of the wounded part, are extremely dangerous, and it is in many instances quite impossible to form an idea of the extent of injury received. The healing of the wound in the parietes should be promoted by suitable means, and as searching for the inward viscera would be contrary to all sound principles of surgery, the symptoms arising from the internal injuries can only be met by medical treatment. Important indications are, to guard against all exciting causes of extravasation, either of blood or of visceral contents, and against all causes of inflammation ; and if inflammation

should occur to endeavour to subdue it by proper treatment. It is, therefore, necessary to abstain from all imprudent exhibitions of stimuli for the removal of the collapse consequent on the injury, to preserve the body in perfect rest in the horizontal position, to enjoin the use of the mildest ingesta, and to abstain from the employment of purgatives, as being calculated, until the injury has been healed, to do harm not only because, by the irritation they produce, they increase the danger of the occurrence of inflammation, and its intensity when it does occur, but also, because by the additional peristaltic motion they increase the risk of extravasation of intestinal contents, and interfere with the process by which nature repairs the injury. These, with all the details of antiphlogistic regimen, constitute important parts of the preventive treatment: and when inflammation occurs, the remedies proper for that state must be promptly applied. If there be reason to suspect injury of the bladder, the catheter should be kept introduced to diminish the chances of extravasation of urine.

3dly. Wounds attended with protrusion without injury of the protruded parts. The protruded parts are usually portions of intestine or omentum, or both; and if uninjured, the sooner they are reduced the better; but all proceedings for that purpose should be conducted with the utmost gentleness, so as not to induce the danger of inflammatory accession, care also being taken, as in hernia, to return that part first which was last protruded,—the mesentery before the intestine, and the intestine before the omentum. By these proceedings the parts are more likely to resume their natural position in the belly, and there is less danger of exciting irritation and inflammation, than by attempting to return the whole *en masse*. For facilitating reduction, the patient should be placed in the most favourable position for the relaxation of the abdominal muscles; the pelvis should be slightly raised, and the chest bent a little forwards. It is an important precaution, to make sure that the reduction is complete, lest if part of the protrusion be not sent into the cavity, but remain embraced by some of the textures forming the aperture, strangulation should ensue. It has happened in some cases where reduction was erroneously supposed to be complete, that the inner part of the wound had so embraced a portion of the protrusion, as to cause fatal strangulation. Considerable difficulty is sometimes experienced in accomplishing reduction, in consequence of the protruded intestine becoming distended with flatus. Various proceedings have been recommended and adopted for overcoming this difficulty. Paré, Dionis, and many others advised the puncture of the intestine with a round needle to allow the flatus to escape; some recommend squeezing back the air into the portion of intestine within the abdomen; but the safer, and indeed, in my opinion, the only justifiable course, when necessary, is, instead of puncturing the intestine, or injuring it by undue and dangerous pressure or handling, to enlarge the opening very slightly. When such a step is absolutely necessary, the incision should be made at the upper rather than at the lower part of the wound, except when the incision in that direction might endanger the internal epigastric artery, or correspond with the umbilicus; and in all instances it should be as limited as possible. The object of both these recommendations is to diminish the danger of ventral hernia afterwards; as

the pressure of the intestines towards the upper is less than towards the lower part of the abdomen. Of course, if by gentle and safe pressure the intestine can be reduced or its contents be so returned as to admit of reduction, no judicious surgeon would venture on the use of the knife. The best instrument for enlarging the opening is the probe-pointed bistoury. Immediate reduction, the greatest gentleness of proceeding, the avoiding all unnecessary and severe handling of, or pressure on, the intestine, the enlarging the aperture when absolutely necessary, the making sure that the reduction is complete, the retaining the parts in the abdomen by suitable treatment until the wound is completely healed, and the guarding by all judicious precautions against the occurrence of inflammation, are the most important points to be attended to in the management of the species of injury now under consideration.

It is curious to observe the opinions which have been entertained regarding Paré's proceeding of puncturing the intestine. It was approved of by Dionis, Rousset, Garengot, Van Swieten, Chopart, Desault, Richerand, Lowe, Sharp, and others. These all agreed in sanctioning the proceeding, but differed among themselves as to the circumstances in which it should be considered justifiable, and also as to the preferable form of instrument for effecting the puncture; some using a broad triangular needle, some a round needle, and some as Richerand a trocar and canula similar to that employed in hydrocele. The proceeding is strongly objected to by Sabatier, La Faye, Blancard, Callesen, Travers, and almost all the higher surgical authorities in Britain; some objecting that a small puncture is insufficient to insure the escape of the flatus, in consequence of the tendency to protrusion of the mucous membrane; and others, that the proceeding is dangerous as well as inefficient.

4thly. Wounds accompanied with protrusion, and also with injury of the protruded parts. Since the special rules applicable to the management of wounds belonging to this class are precisely the same as those for the treatment of the cases of hernia in which the protruded parts are found, in cutting down upon them, to be in an unfit state to be returned into the abdomen, it is scarcely necessary to do more than refer to the section on that subject, and to that on the anatomy and treatment of abnormal anus. The following observations by Mr. Travers will be perused with interest.

"If a gut be punctured, the elasticity of the peritoneum, and the contraction of the muscular fibres, open the wound, and the villous or mucous coat forms a sort of hernial protrusion, and obliterates the aperture. If an incised wound be made, the edges are drawn asunder and everted, so that the mucous coat is elevated in the form of a fleshy lip. If the section be transverse, the lip is broad and bulbous, and acquires tumefaction and redness from the contraction of the circular fibres behind it, which produces, relatively to the everted portion, the appearance of a cervix. If the incision be according to the length of the cylinder, the lip is narrow, and the contraction of the adjacent longitudinal fibres, resisting that of the circular fibres, gives the orifice an oval form. This eversion and contraction are produced by that series of motions which constitutes the peristaltic action of the intestines."

If the wound be very small, consisting of a mere puncture, and more especially if it be at a part of the canal usually not much distended, the most advisable course probably is to return the part, and trust to nature's process for closure; in short, the treatment is replacement without mechanical union.

If the wound be incised, and small, and the intestine otherwise quite free from injury, the edges should be brought together by a single stitch of silk or fine thread introduced by means of a small round sewing-needle, the edges being slightly turned inwards so as to have peritoneal surfaces in apposition. The ends of the silk should be cut off quite close to the knot, and the intestine replaced;—experiments on animals, and experience in the human body proving that the small noose finds its way into the intestinal canal by ulcerative absorption, and is voided with the fæces. Permanent closure of the wound, in cases which proceed favourably, is effected by the assistance of surrounding textures, to which the peritoneal coat of the bowel becomes adherent. The external wound should not be very firmly closed at first, lest extravasation should take place, and the dressings should be as light as possible. In this variety the treatment consists both of mechanical treatment and replacement.

If the wound be not very small, the most judicious procedure is to retain the cut portion at the surface of the wound by one or more stitches connecting the edges of the wound in the intestine with those of the external wounds, and to endeavour to convert the case into one of abnormal or artificial anus;—replacement would be extremely injurious, by incurring the danger of extravasation of intestinal contents.

It will be seen that, in the first of the three classes into which we have arranged wounds accompanied with protrusion and injury of the protruded parts, the treatment at first consists of replacement without mechanical union; in the second, of mechanical union and replacement; and in the third, there is neither mechanical union of the edges of the wound nor replacement, but the lips of the wound of the intestine are retained at the margin of the external wound, and the case is converted into one of abnormal anus, to avoid the danger of fatal extravasation into the peritoneum.

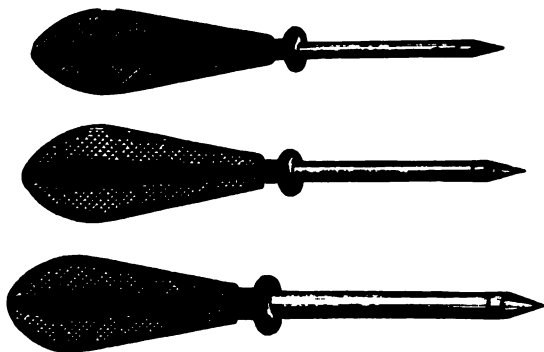
The above are the proceedings which, on the whole, appear to be the most judicious in the treatment of the different varieties of wounds in the intestine, and they are recommended by the great majority of British authorities of the present day. They are very different, however, from many of the singular modes of procedure adopted formerly by many surgeons, and still practised by some. In some cases, ligatures have been employed in great numbers; in others, sutures of every possible form have been used; most extensive wounds of the intestine have been sewed up, and replacement effected; in some instances, the ends of the ligatures have been cut off, the ligatures having been employed only for preserving apposition of the edges of the wound in the intestine; and in others, the ends have been left and kept in the external wound, the ligatures being used partly for procuring apposition of the edges of the wound of the intestine, and partly for keeping that wound near the external one. The methods of Reybard, of Palfyn, of

Jobert, of Ramdohr,¹ of Duverger, and of Sabatier, are some among the many which have been proposed; but as they have never gained the favourable opinion of the most eminent surgeons in this country, it is considered unnecessary to describe them. Much valuable information regarding these injuries will be found in the writings of John Bell, Dr. Thomson, Sir Astley Cooper, Dr. Hennen, and Mr. Travers, as well as in the works of many of the best Continental authorities on surgery.

PARACENTESIS ABDOMINIS.

The usual conditions which warrant the performance of this operation are, either ascites, or ovarian dropsy, when either disease arrives at so advanced a stage, that the pressure on the diaphragm creates a difficulty of breathing,—the object of the operation being to relieve the breathing. The most convenient attitude for the patient to be placed in is the sitting posture, on a chair, or on the side of a bed; and the preferable site for the operation is the *linea alba*, a little below the umbilicus. At one time the operation was performed in the *linea semilunaris*, but as there is danger there of wounding the internal epigastric artery, the former situation is to be preferred. In cases, however, of ovarian dropsy, the pointing of an ovarian cyst may render it necessary to select as the site of the operation the part where the bulging of the sac is perceptible. The patient having been placed in the proper position, and a broad bandage or sheet having been applied round the abdomen, and the ends committed to assistants for the purpose of drawing them

Figs. 170–172.



to keep up pressure while the fluid is being drawn off, the surgeon introduces the trocar and canula through the abdominal parietes in the *linea alba*, about midway between the umbilicus and the pubes, then withdraws the trocar, and when the fluid has escaped through the

¹ That of invagination, as it has been called.

canula, withdraws it also. A piece of adhesive plaster is then placed over the wound, a compress above it, and the whole belly is tightly bound up by the bandage. The bladder should be emptied before the operation, that there may be no danger of wounding it; and, while the fluid is being drawn off, constant pressure should be kept up by means of the bandage, lest dangerous or fatal syncope should result from the sudden accumulation of blood in the abdominal veins on the removal of the support previously afforded by the fluid; or lest, from sudden distension through the same want of support, either one of these veins, or some other vessel, should give way.

CHAPTER XV.

CALCULOUS DISORDERS.

OF the various morbid conditions of the urine, none are of greater interest to the surgeon than those in which various deposits take place. When a deposit takes place subsequently to the expulsion of the urine from the bladder, it is termed *sediment*; when previously, *gravel*. The more remarkable diatheses connected with these deposits are the following:—

I. THE LITHIC DIATHESIS.

Varieties.—The lithic or uric acid deposit may be said in general to assume one or other of two distinct characters, namely, that of amorphous and impalpable sediment, or that of crystallized or massive concretions. Each of these two general divisions presents three varieties.

The amorphous and impalpable sediment consists chiefly of lithic acid, in combination with ammonia. The three varieties of this deposit are the *yellow sediment*, consisting of lithate of ammonia, more or less tinged with the yellow colouring principle of the urine—the *red*, or as it is often called, the *lateritious sediment*, consisting of lithate of ammonia, combined with the yellow colouring principle of the urine and the red or purpurate of ammonia—and the *pink sediment*, the appearance presented when the lithate of ammonia is combined with the red colouring principle, with little or no admixture of the yellow. Strongly marked examples of this last variety are extremely rare.

The crystallized or massive deposit is found in three varieties,—as crystallized sand or gravel, as amorphous concretions, or as pisiform concretions.

Crystallized sand or gravel, consisting of lithic acid with purpuric admixture, is of various forms and colours, according to the nature of the urine from which it is deposited. These crystals to the naked eye much resemble in size and shape the particles of Cayenne pepper, and in colour, when their presence is accompanied by fever, they are usually reddish; when without fever, they more or less resemble the yellow amorphous sediment. [Under the microscope the crystals present the appearances represented in the wood-cut.—Ed.]

Fig. 178.



The *amorphous lithic concretions* present two varieties, the coloured and the white. The former, which are the more common, consist almost entirely of pure lithic acid, and are irregular in form, generally rough on the surface,

and not crystallized within, but appearing as if formed by many different masses being pressed together; in colour being sometimes yellow, sometimes of a dark brown or brownish red. The latter or white variety, consisting of lithate of soda, are extremely rare, irregular in shape and size, soft in texture, and presenting neither a crystallized nor lamellated appearance, but amorphous.

The *pisiform lithic concretions* are in most instances generated in great abundance, and vary in size; in form they are more or less globular; their surface is smooth, in many instances remarkably so; their central parts usually lamellated, and almost invariably crystallized. Their colour varies considerably, being sometimes, although rarely, a dark brown or reddish, but more commonly one or other of the shades of yellow.

Both the amorphous and pisiform lithic concretions are usually generated in the kidney, and they are much more formidable than the other varieties of lithic deposits, inasmuch as there is great risk of their originating the formation of calculi. When lithic deposits take place in old age, they are usually the pisiform.

Causes.—The tendency to lithic deposit is hereditary. It is usually found either in children and young persons under the age of puberty, or in persons from forty to sixty years of age.

The principal exciting causes are, errors in diet, want of sufficient exercise, waste of tissues more rapid than the supply, as in fever, neglect to maintain a clean and proper state of the skin, and atmospheric influence. The habitual use of too much food, especially of animal food, the use of wines or malt liquors, or of any kind of food or drink calculated to produce an excess of hydrochloric acid in the stomach, a cold and moist condition of the atmosphere, or such a state either of the atmosphere or of the skin as tends to prevent the customary evolution of free acid or nitrogenized excretion through the skin, and certain cutaneous diseases, are favourable to the formation of lithic deposits. Free acid generated in the stomach passes off by the urine, and combining with an alkaline base precipitates the lithic acid.

Dr. Prout remarks, "The lithic acid and its compounds we suppose to be principally derived from the albuminous principles, not only of the chyle and blood, but also of the albuminous textures of the body, in the same sense and mode in which we suppose urea and lactic acid to be principally derived from the gelatinous textures. When, on account of the imperfect assimilation of alimentary matters by the stomach and primary assimilating processes, the chylous principles are not raised to that standard of perfection by which they are fitted to become component parts of the blood, we suppose that the healthy kidney possesses the power of selecting and disorganizing such imperfectly developed chylous matters, and of converting them into lithate of ammonia. Such is the presumed origin of most of the *yellow* amorphous sediments occurring to healthy individuals from slight errors in diet, &c.

"During feverish or other derangements, in which the functions of the hepatic system are particularly involved, the lithate of ammonia is not only supposed to be derived from the imperfectly assimilated chyle,

and the deteriorated albuminous principles of the blood; but also from the deranged secondary assimilation of the albuminous textures of the body. The lithate of ammonia thus developed appears in the urine more especially under the forms of the red and pink amorphous sediments; and is distinguished by the large quantities of colouring matters developed in conjunction with it. Lastly, the massive forms of lithic acid deposits are derived from the same sources as the above; but when thus deposited, the lithic acid is secreted, either in connexion with acids which combining with the ammonia of the lithates set the lithic acid free; or in connexion with other bases, as soda, &c., the compounds of lithic acid with which are less soluble than the lithate of ammonia."

Treatment.—Indolence and inactivity being predisposing causes of lithic deposits, exercise, judiciously proportioned to the strength of the patient, and not sufficient to induce fatigue, should be strictly enjoined. The state of the skin should be attended to, and with that view bathing and friction are useful; the clothing should be sufficiently warm to prevent the natural and healthy perspiration from being checked, and if possible, residence in a cold and damp situation should be avoided. Attention to diet is of the greatest importance, and in reference to this part of the treatment, the patient should be cautioned to avoid all kinds of food and drink which are indigestible, or calculated to excite acidity. Malt liquors of all kinds are injurious; wines, especially the sweet and acescent, and hard waters, should be avoided. Animal food should be taken but sparingly; and it is most important that the food generally be not only of the most digestible kind, so as not to excite derangement of the stomach, but also that it be taken in very moderate quantities. Besides, attention to exercise, to the state of the skin, and to the careful regulation of diet, all which are important for diminishing the tendency to the occurrence of lithic deposit, it is advisable to administer alkalies for the purpose of preventing the formation of the lithic acid or of neutralizing it, and also for preventing its precipitation and the consequent danger of aggregation, by offering a soluble base for the acid. Of the different alkalies, potass is by much the preferable, as the salts formed by its combination with lithic acid are soluble; whereas with soda a salt may be formed as insoluble as lithic acid itself.

II. PHOSPHATIC DIATHESIS.

This term does not imply the mere presence, or any excess, of the phosphates in the urine. In the healthy condition of that secretion, the earthy phosphates are eliminated from the body in a state of solution; but in certain states of constitution the balance of the healthy affinities is broken, and the phosphates become deposited in a visible form. To this condition is given the title of phosphatic diathesis.

In the uric acid diathesis, the gravel precipitated is red, whereas in the phosphatic, it is white. In the former, the deposit of lithate of ammonia is determined by an excess of acid; in the latter, by deficiency of acid, or alkalescence of urine. This class of deposits consists of, 1st. The triple phosphate of magnesia and ammonia. 2d. The phosphate

of lime (an exceedingly rare variety); and 8d. Of a mixture of the two former.

The earthy phosphates are readily soluble in urine healthily acid, and, therefore, an excess of them may pass off in acid urine without becoming visible; whereas the minutest quantity becomes visible in alkaline urine, on account of their not being soluble in alkaline fluids. Urine may be alkaline from the formation of a fixed alkali, such as the carbonate of soda, the carbonate of potass, or the alkaline phosphate of soda; but more commonly from the presence of ammonia, constituting what has been called ammoniacal urine, the ammonia being endangered by the decomposition of urea. Phosphate of magnesia is contained in healthy urine, but it is very soluble. If, however, ammonia be engendered, the triple phosphate of ammonia and magnesia which is formed, is insoluble. This triple phosphate may either be precipitated in the form of white crystals, or it may have an amorphous character. [In Fig. 174 the various forms which the triple phosphate exhibits under the microscope are represented. Generally the crystals are sections of a prism; sometimes they have a stellar, foliaceous, or penniform arrangement.—ED.] Of the three deposits above mentioned, the first is the least formidable; the second, as has been already stated, is extremely rare; the third, consisting of a mixture of the two salts, is by far the most frequent, and is also the most formidable.

Fig. 174.



Causes.—The predisposition to the deposit of the earthy phosphates is inherited. The exciting causes act, some generally, others locally; the principal are, long-continued over-exertion, depressing passions, insufficient food, the habitual or long-continued use of debilitating medicines, such as mercury or strong purgatives, the abuse of the alkaline medicines, injuries of the kidneys, organic disease of the kidney, bladder, or prostate gland, and injuries or a morbid condition of the spinal cord. Any influence which unfavourably affects the body generally may be an exciting cause. It is well known that alkaline deposit is often found in consequence of injury of the back, a fact which was pointed out by Sir Benjamin Brodie, as far back as 1807. On this subject an excellent authority remarks, "The immediate link in the chain of connexion between the cord and the urine in these cases, seems commonly to be a chronic inflammatory condition of the mucous membrane of the bladder, the decomposition of urea being effected by the altered mucus." When urine is alkaline from a fixed alkali, no ammonia being present, then instead of the triple phosphate of ammonia and magnesia, the phosphate of lime is thrown down, and may present itself as a fine white sand, or as a film of iridescent appearance on the surface of the urine.

Symptoms.—The urine depositing the triple phosphate is generally abundant, pale-coloured, of low specific gravity. That depositing phosphate of lime has been found in a few instances of a deep colour and acescent when passed, but usually it is of a pale colour, of a low or moderate specific gravity, and becomes alkaline sooner than healthy

urine. That depositing the mixed phosphates, when unattended with disease of the bladder, usually is exceedingly abundant, of a pale colour, of a low specific gravity; and although it may be clear when passed, yet on being exposed to heat it becomes turbid from deposit of the phosphates; when connected with diseased bladder, it is usually alkaline on being passed, and invariably becomes so on cooling; it also becomes very offensive, and with the phosphates deposits large quantities of mucus sometimes tinged with blood. Often, and especially in an advanced stage of the disease, the local and constitutional symptoms attending the phosphatic diathesis, resemble those of disease of the bladder, or of some other organic disease. The constitutional symptoms are subject to considerable modifications; but in all instances where the disease has assumed a permanent character, patients are cachectic, weak, sallow, languid, sleepless, and much affected with nervous irritability, which is evinced in many different ways. The bowels are flatulent and often irregular, and the peristaltic motion accompanied by borborygmi, and patients complain of a feeling of sinking and of pain and weariness in the back and loins on making the least exertion.

Treatment.—In this diathesis the powers of life being in an asthenic condition, the treatment indicated by that condition is what experience has shown to be the most useful, and consists in the use of a generous animal diet, tonics, the mineral acids, such as the nitric or muriatic—both of which in many cases are given with great advantage—the due regulation of the bowels when absolutely necessary, by the very mildest aperients, freedom from care and mental anxiety, and from every kind of exertion calculated to produce an unfavourable impression on the body, exposure to a free bracing atmosphere, and together with these means, the use of sedatives, which are peculiarly indicated by the nervous irritability and anxiety with which patients in this state are so often afflicted. Of all remedies belonging to this class, opium is the most valuable, not only from its effects in relieving nervous irritability, but also from its power of rendering alkaline urine acid. In the severe forms of this disease opiates are necessary, and the preparation which experience has shown to be the most useful is the liquor opii sedativus of Battley.

The above are the principal indications of treatment; and when they are attempted to be fulfilled, the means must be modified according to the particular circumstances of individual cases. Saline draughts, alkaline medicines, saline or reducing purgatives, mercury, malt liquors, acescent vegetables, hard waters, and fruits, are injurious and ought to be avoided.

III. OXALIC DIATHESIS.

In this diathesis the preponderating unnatural ingredient in the urine is oxalic acid; and there is a tendency to the formation of calculus of oxalate of lime in the kidney, if a nucleus exist.

Symptoms.—The distinctive characters of the urine in this diathesis are, that it is remarkably free from sediment, often bright and clear, but sometimes of a pale citron yellow or greenish hue, and of low or

moderate specific gravity, and if condensed by evaporation, or examined by the microscope, the characteristic octohedral crystals are discernible. [Occasionally, small masses are found resembling dumb-bells.—ED.] This diathesis is met with both in the young and the old; but the mulberry calculus is most commonly found in the middle period of life, and in the dyspeptic, and in persons of the sanguine and the melancholic temperaments. The constitutional symptoms vary exceedingly in character and degree, and in some respects are influenced by the peculiarities of temperament of the patients; those of the sanguine temperament being irritable, and those of the melancholic desponding and dejected; the mind having a great tendency to brood over the symptoms of the disease. Uneasiness is experienced during the assimilation of the food; flatulence is complained of, the symptoms of dyspepsia are often very troublesome, and in many instances the patient is annoyed by palpitation. When the diathesis is very marked, the skin in some cases assumes a peculiar hue. On this subject Dr. Prout says, "The skin is apt to assume an unnatural appearance difficult to describe, but the colour of which may be said to vary from dull greenish yellow in the sanguine, to dark olive or livid in the melancholic temperament." A nephritic attack occurs, and if the patient get rid of the calculus, he usually remains for years free from all his uncomfortable symptoms. The oxalate of lime calculus, which forms during the continuance of the diathesis, is hard, and bears a striking resemblance in form and colour to the mulberry, and is hence called the mulberry calculus. In some instances small calculi, consisting of oxalate of lime, are found bearing so close a resemblance to hemp seed, that they have been designated hemp-seed calculi. If they be not carried off by the urine, they pass into the mulberry calculus.

Fig. 175.



Although the mulberry calculus is not common, Dr. Golding Bird has found that small crystals of oxalate of lime are extremely common in the urine, and are discoverable by the microscope, although they do not sink or form a deposit. In slight cases there may be no local or constitutional symptoms, or none sufficiently marked to attract attention, the presence of the diathesis is then discoverable only by the microscope.

Causes.—Some of the exciting causes of this diathesis are believed to be grief, depressing passions, great loss of blood, and residence in a damp and malarious situation. It has been known to follow gout, and to accompany chronic rheumatism. Dr. Prout says, "Diet under all circumstances, but particularly in strongly predisposed habits, has, perhaps, more influence in exciting this diathesis than any other cause. I have seen repeated cases in which the too free use, or rather abuse, of sugar has given occasion to the oxalic acid form of dyspepsia; and sooner or later, under favourable circumstances, to the formation of an oxalate of lime calculus. I have also seen, as before noticed, well-marked instances in which an oxalate of lime nephritic attack has followed the free use of rhubarb (in shape of tarts, &c.), particularly when

the patient has been in the habit, at the same time, of drinking hard water."

Treatment.—The treatment consists principally in attention to diet,—promoting the due performance of the functions of the digestive organs and of the skin, and in the observance of all judicious and proper means for maintaining the general health and strength. The diet should consist of animal and farinaceous food, and as the assimilating process is weakened, even those things which are proper, should be taken in very moderate quantities, and in the lightest and most digestible form. The safest drink is distilled water. If, on account of the habits or condition of the patient, some stimulant should be necessary, brandy and water, taken with food, would be preferable to wine. The condition of the bowels must be carefully attended to, and, when necessary, regulated by the mildest laxatives; the function of the skin must be promoted by sponging, friction, and suitable clothing; and all causes of exhaustion or depression carefully avoided. Of medicinal remedies, the mineral acids, such as the nitric or the muriatic in some tonic infusion, and the nitro-muriatic in some bitter infusion have been found of the greatest service. The effects of the mineral acids must be watched, and their use discontinued when they begin to produce a deposit of lithic acid, or of lithate of ammonia in the urine. On this subject, a great authority expresses himself as follows:—"In cases of this diathesis, when the patient lives at a distance in the country, I commonly recommend the use of the muriatic acid, or nitro-muriatic acid, as the case may be, to be persisted in till the lithate of ammonia, or the lithic acid, begins to appear in the urine; or *for a month*, and by adopting such a course of acids three or four times in the year, and by a carefully-regulated diet, I have seen the diathesis gradually subdued, and at length removed altogether." It is of the greatest importance for persons who have this diathesis, to abstain from sugar, fruits, fermented liquors, all kinds of viands containing oxalic acid, and especially the stalks of rhubarb, and from hard water. By partaking of food containing oxalic acid, and of hard water, which contains the supercarbonate of lime, they would be introducing into their system the very ingredients of the mulberry calculus.

URINARY CALCULI.

Urinary calculi are formed on nuclei of their own substance, or on a clot of blood or mucus, or on some foreign substance introduced into the bladder by the urethra, or in consequence of a wound, or of ulceration. They may be either *renal*, or *vesical*.

CALCULUS IN THE KIDNEY.

The primary nucleus of a renal calculus may be constituted by the simple cohesion of the deposit, or by a clot of blood, or by a particle of the epithelium of the mucous membrane lining the cavities of the kidney—this last being a mode of origin believed to be not unusual after injury or inflammatory attacks of the kidney.

[*Renal calculi* are generally composed of uric acid, although occasionally they are formed of the oxalate or phosphate of lime. Their size

and form is very various. They may be as small as a grain of sand, or they may be so large as to prevent their escape from the kidney by the ureter.

Remarkable specimens of this kind were obtained by the editor, a few years since, from a little girl twelve years of age. The kidneys were

Fig. 176.



Fig. 177.



much enlarged, and the pelvis, calices, and infundibulæ greatly distended by the calculi. The parietes were so thin, and the structure so altered that none of the characteristic appearances of the gland could be observed. When removed from the loins they felt like membranous sacs filled with stones. Upon fitting together the fragments they presented the arborescent figures of the actual size and form represented in the wood-cuts, with numerous stems and buds, forming a cast of the dilated cavities of the kidney. The buds, or the enlargements corresponding with the infundibula, were composed of clusters of beautiful shining crystals. Dr. Bridges analysed them, and found them to be composed of the phosphate of lime. Their weight was five hundred and ten grains.

The presence of these calculi was not suspected before death, although the sandy and ropy character of the urine, and the pain in the lumbar regions, gave indications of nephritic disease. The child died from hectic produced by inflammation of the kidneys.

In some few instances the stone has created an abscess in the kidney, and has been discharged through the loins.

Figs. 176, 177. Renal Calculi. From Dr. Neill's paper in the *American Journal*, July, 1849.

The affection may be considered a slow and painful one; and if it occur on both sides, producing inflammation of the kidneys, would likely prove fatal.

Yet a person may carry a small stone in the kidney for some time and feel no pain; but if, from some exertion, the stone be broken, or change its position, the pain would be severe, and extend to the groin.

When the stone is so small as to escape from the pelvis of the kidney and descend the ureter, it gives rise to those painful and distressing symptoms frequently spoken of as a fit of the gravel.

The symptoms are more severe when the stone is rough and large, and they continue as long as the stone is passing along the ureter, which may occupy from twelve to forty-eight hours. The pain commences in the loins, and extends to the groin and testicle, which is generally retracted. The patient suffers from sick stomach, and often vomits. At the same time there is prostration, the skin becoming pallid and covered with cold perspiration. The symptoms generally subside suddenly, owing to the entrance of the calculus into the bladder, but Sir Astley Cooper records several cases which terminated fatally, owing to the stone completely filling up the ureter, which became much distended with urine and pus. In one instance the ureter burst, and the contents were discharged into the abdomen.

Treatment.—Should a stone be diagnosticated in the kidney, it would be important to determine the diathesis of the patient, and to prevent the increase of the deposit by such remedies as have already been pointed out. At the same time its escape from the kidney is to be promoted by diluents and diuretics. But should it be too large to pass, and give pain by exciting inflammation of the kidney, cups should be applied to the loins, and opiate enemata administered.

The same kind of treatment would be required when the stone is passing down the ureter. If the patient be robust and vigorous he should be bled freely. Owing to the excessive pain, it may be necessary to give larger doses of opium, as well as to employ the opiate enemata. Relaxation of the ureter, and relief from pain may also be expected from the hot bath and laxative medicines. Should the stone become impacted in the ureter, it is possible that it may be discharged by ulceration through the parietes of the abdomen.

CALCULUS IN THE BLADDER.

The description of urinary calculi in Dr. Gross's "Practical Treatise on the Diseases of the Urinary Organs," is so complete that the editor conceives that he cannot do better than to present a large portion of it to the student.

"Stone occurs at all *periods of life*, from the most tender infancy to the most decrepit old age. Indeed, there is reason to believe that it occasionally exists as an intra-uterine affection. Geyer¹ relates the case of a boy who suffered from calculus of the bladder from birth. He was cut in his twelfth year, when the stone had acquired so large a bulk that it had to be broken before it could be extracted. The

¹ Miscel. Nat. Curios., Dec. 11, An. V. p. 456.

whole mass weighed ten ounces. Stahl¹ found a calculus of the size of a peach-kernel, in an infant of three weeks, that had suffered great distress from its birth in passing its water. Similar examples are mentioned by Nicolai,² Armstrong,³ Richel,⁴ Greding,⁵ Nosäus,⁶ and others.

"Of 5876 cases mentioned by Civiale, in his treatise on Calculous Affections, 2416 were children, 2167 adults, and 793 old persons; 1946 occurred before the age of ten, 948 from ten to twenty, 460 from twenty to thirty, 380 from thirty to forty, 391 from forty to fifty, 513 from fifty to sixty, 577 from sixty to seventy, 199 from seventy to eighty, and 17 after eighty.⁷

"Children are more subject to this disease in certain districts than in others, and the same is true in regard to adults. The greater proportion of calculous cases in Wirtemberg, in the mountains of Switzerland, the Neapolitan States, and in some of the counties of England, especially Norfolk, occurs in young persons, from causes hitherto unexplained. In the United States, a larger number of children are affected with this disorder in Kentucky, Ohio, Tennessee, and Alabama, than in any other regions. Pennsylvania, Virginia, Maryland, the two Carolinas, Georgia, Florida, Louisiana, and Arkansas, also furnish a considerable number of cases. The inhabitants of Missouri, Iowa, Wisconsin, Michigan, Indiana, New York, and New Jersey are comparatively exempt; and in the New England States generally a case of calculus of the bladder is so rare as to excite the surprise of the observer. In Canada and the other British Provinces of North America the disorder is also very infrequent: at all events, none of the surgeons of these regions have acquired much reputation as lithotomists, and but few cases of stone are brought from thence into this country. We are justified, therefore, in believing that the malady is uncommon there. The same remarks are applicable to Texas, Mexico, and California, as I have assured myself by repeated inquiries from respectable and intelligent practitioners in those territories. The causes of these differences have not been ascertained; attempts have been made to trace them to the effects of climate, and to the influence of the water, food, and habits of the people, but without success.

"It is not satisfactorily ascertained whether this affection is *hereditary*. Facts certainly warrant the inference that it is. Thus, Civiale relates the case of a man on whom he practised lithotomy, whose mother had had stone, and one of whose children died of it. He also performed the operation on two brothers, whose grandfather and two uncles had laboured under the disorder. Prout speaks of a family in which the father, son, and grandson were all affected with uric acid calculi. I have not met with any cases illustrative of the present topic.

¹ Diss. De Morb. Fœtum in Utero Materno, S. 6.

² Von Erzeugung der Kinds im Mutter Leibe, Halle, 1746, p. 223.

³ Ueber die Gewöhlichen Krankheiten Regensb. 1788.

⁴ Voigtel's Handbuch der Path. Anatomie, 8 B. p. 289.

⁵ In Ludwigi Advers. Med. Pract. Vol. iii. P. iv. p. 742.

⁶ Jour. de Médecine, T. lxxii. p. 369.

⁷ See the Author's edition of Liston's Surgery, p. 581. Philad. 1846.

"*Coloured persons* appear to be remarkably exempt from calculous complaints. Whether this is the case in all countries where the negro resides I am not informed, but it is certain that the circumstance obtains, in an eminent degree, in the black population of the Southwest. During a residence of ten years in Kentucky, I do not recollect to have met with a solitary example of gravel or stone in a coloured person. My impression is that Dr. Dudley in his large calculous practice has never cut more than two or three individuals of this description. To what this immunity is due, our knowledge does not enable us to determine. The circumstance is so much the more surprising when it is remembered that the coloured people of that region are constantly exposed to hard labour, and that their fare is often of the coarsest character.

"Urinary calculi are much more frequent in men than women, because they are more constantly exposed to the exciting causes of the complaint; and secondly, because the more complicated structure of the urinary apparatus, which prevents the ready discharge of sabulous matter, and thus favours the formation of stone. But for the latter circumstance, the probability is that young girls would suffer nearly as often as boys.

"What influence, if any, *occupation* exerts upon the production of this disorder, we have no statistical facts to determine. In the southwestern states, especially in Ohio, Kentucky, and Tennessee, the great majority of calculous subjects are farmers and mechanics, or the sons of persons of this description; and the same is true, I suppose, of the calculous cases in the other states. Persons who are habitually exposed to cold and wet are said to be particularly prone to this complaint; the fact, however, if it be one, requires confirmation before it can be received as true. It has been already shown, as it regards sailors, who were formerly supposed to be very liable to stone of the bladder, that they are extremely exempt from it.

"*Climate*, doubtless, exercises no little influence in the formation of urinary concretions. It has been already stated that, in the United States, this disease is most common in Ohio, Kentucky, Tennessee, and Alabama; a circumstance which, so far as is known, does not depend upon any peculiarity of living, and which may therefore be supposed to be owing to some mysterious operation of the climate. In Holland calculous disorders are very common, and the circumstance is the more remarkable, because of the great use that is made of gin, which is a powerful diuretic. That this liquor is not the cause of this occurrence is proved by the fact that the Dutch colonists of Batavia, in the island of Java, whose habits are not at all dissimilar from those of the people of the mother-country, are almost entirely exempt from this affection. Semmering informs us that the disease is altogether unknown in some situations bordering on the Rhine.¹ Calculous affections are, as was stated before, much more common in Norfolk than in any other part of England, and yet the habits of the residents there are the same as in the other counties. In the East Indies, stone is comparatively unusual, though not so much so as was formerly imagined. We have already

¹ Coulson on the Bladder, p. 166. London, 1842.

seen that it is proverbially uncommon in New England. It is hardly safe, however, to indulge in any remarks concerning a subject which is involved in so much obscurity as the one under consideration. Much of what has been advanced is wholly conjectural, and, therefore, scarcely worthy of serious attention. Patient and multiplied observations in different parts of the world are alone competent to furnish us with any real and substantial light; for these we must wait before we are justified in coming to any positive conclusion."

"Many respectable writers and practitioners are of opinion that the production of calculous diseases is promoted by the use of hard, impure water, in consequence of the changes which it is supposed to induce in the renal secretion. The opinion is plausible, and may be true, but how far, or to what extent, nobody has attempted to decide. If it be true that in Kentucky, Alabama, Tennessee, and Ohio, most calculous cases occur in limestone regions, it is equally true that many are found in the freestone districts of those states."¹

The most frequent origin of a vesical calculus is the descent of a renal calculus, and its retention in the bladder. This in most instances furnishes the nucleus, which, however, sometimes originates in a drop of blood or of mucus. In some cases, calculi are formed on nuclei of their own substance deposited in the bladder; and in others, nucleus is a foreign substance introduced into the bladder from without. In the great majority of instances, however, the nucleus is provided by the urinary organs themselves, and aggregation may go on at the original site of formation, or descent may take place into the bladder. The calculi that originate in the kidney, on nuclei of their own substance are the uric acid, and the oxalate of lime, but most frequently the former; whereas those which originate in the bladder, on nuclei of their own substance, are the phosphatic, and the cystic oxide calculi.

["In many instances, however, the concretion is formed round a foreign body, introduced either by the patient himself through design or accident, or in the same manner by a second party. A person shot in battle has been known, at a subsequent period, to suffer from stone in the bladder, in consequence of the ball having lodged in that organ, and thus invited, as it were, a deposit of calcareous matter. A surgeon may become the innocent cause of a similar occurrence. In treating a diseased urethra, or in exploring this canal, the bladder, or the prostate gland, the catheter, bougie, or sound which he uses may break off, and afterwards lead to the development of a stone. Many such cases are upon record. A great variety of substances, as nails, tacks, bullets, needle-cases, fruit-stones, peas, beans, pebbles, tents, hairs, small keys, pipe-stems, glass tubes, grass stalks, pieces of straw, pins, and needles, have been accidentally lodged in the bladder, by patients endeavouring to relieve stricture, to procure evacuations of urine, to excite onanism, or create public sympathy. Examples of this kind are, for obvious reasons, more common in the female than in the male. O'Brien relates² an instance in which the nucleus consisted of a human tooth; Liston,³ one in which it was formed by a brass ring; and Malago,⁴ one in which

¹ Dr. Gross, on Diseases and Injuries of the Bladder, p. 342-346.

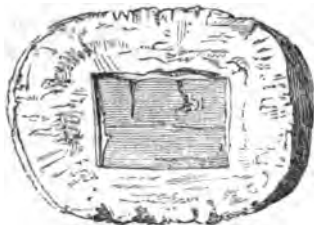
² Dublin Journal of Medical Science for March, 1834.

³ Edinb. Med. & Surg. Jour., vol. xix. p. 57.

⁴ Filastre Seberio, 1845.

it was composed of a globule of mercury. In my private collection is a portion of calculus, presented to me by Dr. Jetton, of Tennessee, which contains three of the caudal bones of a squirrel. The man from whom it was removed was thirty-five years of age, and the probability is that he was in the habit of exciting onanism with the tail of this animal, a piece of which broke off, and slipped into the bladder in an attempt of this kind. In the annexed drawing, taken from a preparation in the

Fig. 178.



cabinet of Dr. Sabine, of New York, the nucleus consists of a piece of cork. Dr. Van Buren, son-in-law of Dr. Mott, and one of the surgeons of the Bellevue Hospital, informs me that he has a stone, the nucleus of which is formed by the head of a stalk of wheat. It was removed from a man nearly seventy years of age. He had introduced the straw for an improper purpose, and the barbs no doubt prevented

its retraction; the consequence was that it passed beyond his reach, and ultimately into the bladder.

"The nucleus varies much in its size, colour, form, and consistence. Although generally single, it is sometimes double, triple, and even quadruple: its situation is not always strictly central. The instances in which the concretion is hollow, or the nucleus loose, are rare.

"Calculi vary much in their *number*. In general, there is only one; now and then there are two or three; and sometimes, though rarely, there are several dozens, or even several hundred. The largest number I have ever found was fifty-four, which I removed from the bladder of an old gentleman, upwards of seventy-six years of age, from Oldham County, Kentucky. They were of a dull whitish colour, smooth, irregular in their shape, and from the size of the kernel of a filbert to that of a common marble. Fifty-five were found in the bladder of the celebrated Buffon. Examples are mentioned of sixty, seventy, eighty, ninety-six, and one hundred. The greatest number ever extracted by Sir Astley Cooper was one hundred and forty-two. Dessault took upwards of two hundred from the bladder of a priest. Similar instances are mentioned by Krüger, Dupuytren, and others. Dr. John Kelly,¹ of the State of New York, has published a case of two hundred and twenty-eight. Tulpius, Boerhaave, Beauchene, and Ribes each record a case of three hundred or upwards. In the instance mentioned by the latter, this number was found after death in a man who had previously undergone the operation of lithotomy three times. Murat met with six hundred and seventy-eight. Schurig, in his "*Lithology*," refers to a case of seven hundred. The most extraordinary example, however, upon record, occurred in the practice of the late Dr. Physick, who extracted from Judge Marshall, of the Supreme Court of the United States, upwards of one thousand calculi, from the size of a partridge shot to that of a bean. They were all of an oval shape, and marked each by a small black spot."

¹ Amer. Jour. Med. Sciences, Jan., 1847, p. 246.

² Gibson's Institutes of Surgery, xi. p. 220. Fifth edition.

"The mulberry calculus is almost always solitary; and the same is true, but not to the same extent, of the uric calculus. The phosphatic calculus, on the contrary, is not unfrequently multiple. When the concretions are numerous, they are always proportionably small, and more or less smooth on the surface, from the constant friction which they exert upon each other in the bladder. On the other hand, solitary stones are generally rough, and comparatively large.

"The *volume* of urinary concretions ranges between a hemp-seed and a cocoa-nut. In the great majority of instances it does not exceed that of an almond, a pullet's egg, or a walnut, the latter of which indeed it seldom reaches. In young subjects, and in recent cases generally, the size is usually inconsiderable. I have a number of calculi, extracted from children from three to five years of age, which, in their volume, hardly equal a common marble. The size of a urinary concretion, however, does not necessarily depend upon the period of its sojourn in the bladder, or the age of the patient. Occasionally it increases very rapidly, so as to attain a considerable bulk in a very few months; and, on the other hand, it may remain small for many years. In 1844, I operated upon a man twenty-six years old, who had laboured under well-marked calculous symptoms from his earliest infancy, and yet the stone was hardly as big as a hen's egg.

"The chemical constitution appears to exert no inconsiderable influence upon the volume of urinary concretions; thus, the ammoniacomagnesian and the fusible calculi are capable of attaining a very large size, while the uric, oxalic, cystic, xanthic, and fibrinous, are almost always comparatively small, no matter what may be their own age or the age of the patient. This fact is interesting in a practical point of view; because, by ascertaining the calculous diathesis of the sufferer, we shall be able to form a tolerably correct idea as to the volume of the stone under which he is labouring.

"It has been already seen, that when urinary calculi coexist in great numbers, they are always proportionably small. In the most remarkable case of this kind upon record,—that of Judge Marshall, previously referred to,—the size of none of the concretions, which amounted to upwards of one thousand, exceeded that of a bean, while many of them were not larger than a partridge shot. It is worthy of remark also, that under these circumstances, the individual calculi are generally of unequal dimensions.

"The consideration of the *weight* of urinary concretions is necessarily connected with that of their volume. In general this does not exceed a few drachms or ounces. Out of every one hundred calculi, as they occur in the cabinets of different institutions, or private individuals, few will be found to weigh more than five or six drachms. The smallest probably ever removed by operation was one of ten grains, extracted by Mr. Martineau, of Norwich, England, from a boy thirteen years old. Many examples, however, are recorded of four, six, eight, ten, twelve, fifteen, and even sixteen ounces. Instances of eighteen, nineteen, and twenty ounces, are related by Borellus, Lusitanus, Cheselden, Pauw, Foschini, Wrisberg, and Sandifort. Fabricius Hildanus describes a calculus which weighed twenty-two ounces, and was four inches and a

half in length, by three and a half in breadth. Examples of from twenty-four to thirty ounces are recorded by Deschamps, Pauw, Paget, Tolet, King, and other authors. In the case mentioned by the latter,¹ the patient, who was forty-six years of age, had suffered from his infancy, and the stone was seven inches and a half long, by fifteen inches in circumference. Several instances exist in which the concretion weighed thirty-five, forty, forty-five, and even fifty ounces. Mr. Henry Earle,² of London, has published the particulars of a calculus which weighed forty-four ounces, and was sixteen inches in circumference. It was impossible to break it, and the operator was compelled to leave his task unfinished. Deschamps gives a case of fifty-one ounces; Verduc, one of three pounds three ounces; and, as if to cap the climax, Kesselring³ one of upwards of six pounds.

"Not a little diversity obtains in respect to the *consistence* of vesical concretions. As a general rule, it may be said to vary from that of semi-concrete mortar, chalk, or wax, to that of stone or marble. The hardest calculi are the oxalic and uric, which generally emit a clear sound when struck with steel, and cannot be fractured without a considerable degree of force. Calculi, on the other hand, composed of ammoniaco-magnesian phosphate and phosphate of lime, are friable, and easily reduced to powder. In extracting such concretions from the bladder, they not unfrequently break under the pressure of the forceps. The cystic and fibrinous calculi are quite soft, the latter scarcely equaling that of yellow wax. It often happens that one part of a stone is hard and compact, while another is soft, friable, or even pulverulent. This diversity of consistence is strikingly exhibited in what are denominated the alternating calculi, and seems to depend, in great measure, if not entirely, upon the component elements of the different layers of which such concretions consist. It is not improbable that the age of a stone may exert some influence upon its consistence, though it is impossible to estimate the amount or degree of it.

"Stones are occasionally composed of a mixture of sabulous matter and hair, more or less intimately matted together. Their consistence resembles that of old lath-plaster; they are easily crushed, or pulverized, and they are of whitish, grayish, or pale drab colour. Their formation is of rare occurrence, and they appear to consist principally of phosphate of lime and magnesia. Where the hair comes from is not ascertained.

"The *colour* of these bodies is not less variable than their other physical properties. The most common shades are white, grayish, drab, fawn, reddish, rose, and brown. Concretions of a bluish, greenish, black, or slate colour are rare. In the alternating calculi, a combination of tints is generally observable, and even one part of the surface of a stone may differ essentially, in this respect, from another. The cystic and fibrinous calculi are of a yellow colour, not unlike that of yellow wax; the phosphatic are whitish or grayish; the oxalic, dark or blackish; the uric, rose, reddish, or brown.

¹ London Medical and Physical Journal for 1828.

² London Medico-Chir. Trans., vol. xi. p. 82.

³ Commer. Lâter. Norimb. 1789, hebdom. 9.

"Most calculi, at the moment of their extraction from the bladder, and for a short time afterwards, emit a strong urinous odour, which they gradually lose by exposure to the atmosphere. It may also be completely destroyed by ablution in warm water, and rapid desiccation before the fire. More or less, however, of the animal matter is usually retained, so that maceration at any future time, if not too remote, is apt to be followed by a slight reproduction of the original odour. When sawed, rasped, or rubbed, urinary concretions give out a smell similar to that of bone, horn, or ivory. Fourcroy considered the spermaceti odour furnished by mulberry calculi, thus treated, as characteristic of the species; this, however, is a mistake.

"Vesical calculi are capable of assuming a great variety of *forms*. The circumstances which are chiefly concerned in producing this result are the action of the bladder, the friction which the concretions, when multiple, exert upon one another, and the nature of the nucleus. One of the most constant symptoms of vesical calculus is a frequent micturition, at the close of which the bladder always contracts violently upon the foreign body. When this contraction is uniform, the concretion will be likely to be of a regular figure; but the reverse when this power is exerted unequally. The attrition which vesical calculi, when multiple, experience from the friction to which they are incessantly exposed, seldom fails to effect a change in their configuration. Such concretions are nearly always smooth, angular, and more or less polished, while, on the contrary, the solitary are generally rough, and comparatively regular in their shape. The influence exerted by the nucleus in moulding the form of the concretion is well illustrated by those cases in which the deposits take place round a foreign body, as a bullet, pin, needle, or bit of bougie, accidentally introduced into the bladder. The configuration of the stone, under such circumstances, almost always partakes of that of the extraneous substance. Finally, it is not unlikely that the chemical constitution exerts more or less influence upon the form of the concretion.

"Vesical calculi are commonly of an oval form, but occasionally they are round, spherical, or even cylindrical. Other varieties of form are sometimes seen, as the conical, pyriform, cubic, triangular, pyramidal, gourd-like, polygonal, and the tetrahedral. Sometimes the concretion is thin and flat, like a coin, lenticular, semilunar, or in the shape of a mushroom, a kidney, a mulberry, a bean, or a heart. Again, it may be large and bulbous at the extremities, and narrow at the middle, like a dumb-bell. Dr. Mussey, Professor of Surgery in the Medical College of Ohio, has a most singular-shaped calculus, which he removed, many years ago, from the bladder of a man after death. It has a very delicate nucleus, from which a number of slender prongs project, of an irregularly cylindrical shape, and some of them upwards of an inch in length. A large concretion will occasionally assume the form of the bladder, and have even prolongations or projections, representing the shape of the urethra, the ducts of the prostate gland, or the ureters. In fact, there is no end to the grotesque appearance of these foreign bodies. Morgagni speaks of a perforated stone, voided by a female.

"The shape of a calculus is sometimes materially influenced by that

of its nucleus. If this is very long, as when it consists of a piece of catheter, bougie, straw, or flower-stalk, the concretion will also be apt to be long and slender, the reverse being the case when the nucleus is rounded, or ovoidal. The fact is interesting in regard to the manner in which the foreign body should be seized with the forceps, with a view to its removal from the bladder, whether this be attempted by incision, or the natural channel.

"The *surface* of these concretions may be smooth or rough. The former is generally the case when several exist together, from the friction which they exert upon each other; when there is only one, however, it is almost always rough. From the cause just mentioned, multiple calculi may not only be smooth but even highly polished, and rendered angular, polygonal, rhomboidal, or tetrahedral. The oxalic concretion derives its common name from the roughness of its surface, which resembles that of fruit of the mulberry. The uric acid calculus is usually finely tuberculated. In some of these foreign bodies the surface is scabrous, mammillated, knotty, convoluted, or covered with spines, prongs, or stalactites.

"The *chemical composition* of urinary calculi has attracted much attention during the last fifty years, and the individuals who have particularly distinguished themselves for their researches in this respect are Scheele, Bergmann, Wollaston, Brande, Marcet, Fourcroy, Prout, Berzelius, Henry, Scharling, Taylor, and Bird. In this country, the most valuable contribution that has been made to this branch of the chemical science is from the pen of Professor Peter, of Kentucky. His paper, which was originally published in the fifth volume of the *Western Lancet*, is founded upon an analysis of eighty-one calculi in the museum of the medical department of Transylvania University, and is one of deep interest in reference especially to the relative frequency of stone in Lexington, and the probable causes by which it is induced. To this paper, which has since appeared in a separate form, I beg leave to refer the attention of the reader for a large amount of valuable information, having a direct bearing upon the nature and composition of urinary concretions in a region of country where calculous affections are more common than in any other parts of America. It is to be hoped that the labours of Dr. Peter will have the effect of stimulating others to similar investigations; for it is only by the combined researches of chemical philosophers in different portions of the country that the subject can be placed in its true light.

"The subjoined account, which is transferred, with little alteration, from my work on *Pathological Anatomy*, includes the most important species of urinary concretions that have hitherto been described.

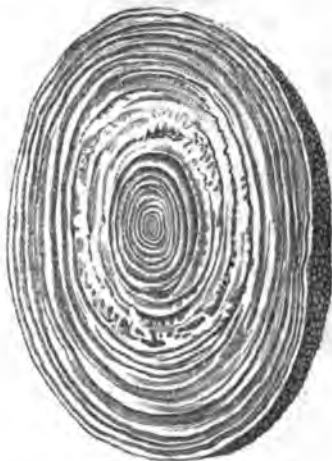
"The *uric* calculus, called also the *lithic* calculus, the most common species of all, was first noticed by Scheele, in 1776. In its colour it is brownish, inclining to that of mahogany, of a flattened oval shape, occasionally finely tuberculated on the surface, but most generally smooth, though not polished, unless there are several concretions at the same time, and from the size of a currant to that of a hen's egg. If the uric calculus be divided with the saw, it will be found to consist of several layers arranged concentrically around a common nucleus, the laminæ being

frequently distinguishable from each other by a slight difference in colour, and sometimes by the interposition of other ingredients. Water has but little action upon it; it is perfectly dissolved by caustic potash; and disappears with effervescence in hot nitric acid, the solution affording on evaporation to dryness, a bright carmine-coloured residue; before the blow-pipe, it becomes black, emits a peculiar animal odour, and is gradually consumed, leaving a minute quantity of white, alkaline ashes. Fig. 179 shows the oval shape and finely tuberculated surface of the calculus; Fig. 180 the internal concentric layers.

Fig. 179.



Fig. 180.



“As a variety of the preceding the *uro-ammoniac* calculus may be here mentioned. It is principally observed in children, and is so extremely rare that several distinguished chemists have been induced to deny its existence. It is generally of small size, with a smooth surface, of a clay colour, and composed of concentric rings, which present a very fine earthy appearance when fractured. Much more soluble in water than the uric calculus, it gives out a strong ammoniacal smell when heated with caustic potash, and deflagrates remarkably below the blow-pipe. This variety of calculous concretion was first described by Fourcroy.

“Next to the uric calculus, in point of frequency, is the *oxalic*, which is generally of a dark brown colour, and tuberculated on the surface, very hard, compact, and imperfectly laminated, seldom larger than a walnut, spherical, and always single. Under the blow-pipe, it expands and effloresces into a white powder; it dissolves slowly in muriatic and nitric acid, provided it be previously well broken up. In the alkalis, it is perfectly insoluble. This species of urinary concretion, called by many the *mulberry* calculus, from its resemblance to the fruit of the mulberry, was first correctly analyzed, in 1797, by Dr. Wollaston, who proved it to consist essentially of oxalate of lime. Figs. 181 and 182 show the external appearance and internal structure of this concretion.

Fig. 181.



Fig. 182.



“ A variety of this species of calculus has been described by Fig. 183. the term *hemp-seed*, from some resemblance which it bears in colour and lustre to that substance. Fig. 183. It is always of small size, remarkably smooth, and generally exists in considerable numbers, being rarely if ever found alone.



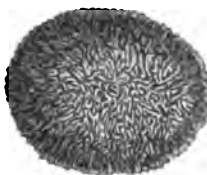
“ The *phosphatic* calculus, Fig. 184, described by Wollaston in 1797, is of a pale brownish colour, and of a loosely laminated structure, with a smooth, polished surface, like porcelain. The shape is mostly oval, and the size, though generally small, is sometimes very considerable. It whitens when exposed to the blow-pipe, but does not fuse; and readily dissolves in muriatic acid, without effervescence. This calculus, composed essentially of phosphate of lime, is extremely rare, as forming entire concretions, but frequently constitutes alternate layers with other matters. It is sometimes called the *bone-earth* calculus, and occasionally contains small quantities of carbonate of lime.

Fig. 184.



“ The next species is the *ammoniaco-magnesian*, so called from its being composed of the phosphate of ammonia and magnesia. Fig. 185. This mixed calculus is of a white colour, friable, crystallized on the surface, and looks a good deal like a mass of chalk: its texture being never laminated, it easily dissolves in dilute acids, but is insoluble in caustic potash; before the blow-pipe, it exhales an ammoniacal odour, and at length melts into a vitreous substance. This species of concretion, first noticed

Fig. 185.



by Wollaston in 1797, sometimes attains an immense size. In a case mentioned by Dr. Thompson, the circumference was fourteen inches, and the weight nearly two pounds.

“ The *fusible* calculus, the nature of which was first determined by Wollaston, consists of a combination of the last two. It is of a white colour, extremely brittle, leaves a soft dust on the fingers, and is easily separated into layers; when broken, it presents a ragged, uneven surface. It is insoluble in caustic potash, but gives off ammonia; and, under the blow-pipe, it is readily converted into a transparent, pearly-

looking glass. This concretion is very common, and sometimes attains a very large size. It is frequently met with as an incrustation of foreign bodies. Figs. 186 and 187 exhibit the outer appearance and internal structure of this concretion.

Fig. 186.



Fig. 187.

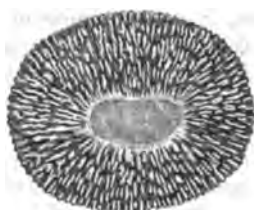


“A very rare species of urinary concretion is the *Cystic*, so called from an erroneous supposition that it was peculiar to the bladder. It consists of a confused, crystallized mass, of a white yellowish colour, with smooth surface. The structure is compact, and the fracture exhibits a peculiar glistening lustre, like that of a body having a high refractive density. It exhales a strong characteristic odour under the blow-pipe, and is very abundantly dissolved in acids and alkalies, with both of which it crystallizes. This species is commonly of an irregular spherical shape, and seldom attains a large volume. Wollaston termed it an oxide, and gave it the name of cystic, from a belief that it occurred exclusively in the urinary bladder. It has since been detected, however, in the kidney. The external and internal appearances of the cystic calculus, are shown in Figs. 188 and 189.

Fig. 188.



Fig. 189.



“The *xanthic* calculus was first pointed out by Dr. Marcet, whose account of it is the best that is extant. It is extremely rare. Its

texture is compact, hard, and laminated: its colour is of a cinnamon brown, its surface smooth, and its volume small. It dissolves very readily in acids and alkalies, and is gradually consumed before the blow-pipe, leaving a minute quantity of white ashes.

"There is what is called the *fibrinous* calculus. Like the preceding species, this is also extremely rare, and appears to be composed principally of the fibrin of the blood, a property to which it owes its name, and by which it is characterized. Sir Benjamin Brodie¹ has described a concretion of this kind, which was about the size of a horse-bean, of an oval shape, and of a yellow transparent appearance, not unlike amber, but less hard. When dried, it shrunk to a small size, and became considerably shrivelled.

"Finally, there is a concretion recently described by Heller, under the name of *urostealith*. It is exceedingly rare, and I do not know that anybody else has noticed it. The specimen, analyzed by the German chemist, was obtained from a man of tolerably good constitution, twenty-four years of age, whose chief complaint was pain in the region of the right kidney, with difficulty in micturition. The concretions were of a rounded form, soft, elastic, and from the volume of a hemp-seed to that of a hazel-nut, most of them being as large as a pea. They become brittle on being dried, when they present the appearance of wax, of a greenish-yellow hue when viewed by transmitted light. When heated, they melt, and emit a peculiar pungent odour, similar to that of benzoin. Urostealith is readily dissolved by ether and by solutions of caustic potash, but it is insoluble in boiling water, and nearly so in alcohol. It seems to be composed of a particular kind of fatty matter."²—(Dr. Gross, on Diseases and Injuries of the Bladder, p. 347-359.)—Ed.]

SYMPTOMS OF CALCULUS IN THE BLADDER.

The leading symptoms produced by a calculus in the bladder are, a frequent, sudden, and urgent desire to pass water, the desire being often irresistible, especially under exercise, or on change of position,—and pain referred to the point of the penis, most severe, just as the bladder is emptied, and after making water, when the contraction of the middle coat brings the mucous coat into distinct contact with the calculus. The pain is sometimes of a burning character; at other times, it is a severe, but dull pain, with a sensation as of something lodged at the part, and giving rise to a desire to pull and pinch the prepuce, causing it to become elongated. The skin of the fore-finger and thumb, especially in children, in whom the inclination to pull the prepuce is often observed, becomes, in consequence of being kept wet by the urine, sodden and white like that of a washerwoman's hands. Sometimes the flow of the urine is suddenly stopped by the stone covering the inner orifice of the urethra, and is restored on a change of posture removing the stone from that position. As the stone increases in size, the symptoms become more and more urgent; the pain at the point of the penis is frequently accompanied by sympathetic pain about the rectum similar to tenesmus; and in most instances, after the disease has been of long standing, the

¹ Lectures on the Urinary Organs, p. 214, second edition. London, 1835.

² Simon's Animal Chemistry, p. 685, Phila. 1846; also Markwick on Urine, p. 98, Phila. 1848.

urine ceases to be so clear and transparent as natural, and deposits on cooling, especially after exercise, a quantity of mucus.

Such are the leading symptoms caused by a stone of moderate size; but, in the course of time, these symptoms become painfully aggravated, other local symptoms supervene, and the general health, at first little affected, becomes impaired, so that the patient's situation is rendered peculiarly distressing. The urine, instead of preserving its natural clear and transparent appearance, becomes at first merely opalescent from the mucus thrown off by the lining membrane; which mucus is seen, as the urine cools, to subside to the bottom of the recipient vessel, and in some cases, is at times tinged with blood. As the disease advances, the congestion of the lining membrane goes on to inflammation, in which state its sensibility is greatly increased, the desire to make water is almost constant, the pain most excruciating, the urine offensive, and loaded with mucus, tinged with blood, its smell foetid and ammoniacal, and by and by, it contains purulent matter along with the mucus. Inflammation of the mucous membrane aggravates all the symptoms to a very great degree; the pain at the point of the penis is excruciating and attended with the inclination to squeeze the glans penis,—the agony being no doubt caused by the inflamed bladder spasmodically grasping the stone. The sympathetic pains are often very distressing, and are felt shooting down the thighs, and in the soles of the feet. The rectum is not only affected by such pains, but it also becomes irritable, and often liable to prolapsus ani, or to hemorrhoids.

The above are the leading and diagnostic symptoms of stone in the bladder; but as some of them are somewhat similar to the symptoms of other affections, such as disease of the bladder, disease of the prostate gland, organic disease of the kidney, renal calculus, and (to some extent) organic disease of the rectum, the surgeon should, before giving a positive opinion, make use of the sound, and when, by means of this instrument, he feels the calculus, he is as fully convinced of its existence as if he actually saw it.

VARIETIES AS TO THE DEGREE OF PAIN IN DIFFERENT PERSONS, AND IN THE SAME PERSON AT DIFFERENT TIMES.

The degree of pain produced by a vesical calculus varies much in different cases, and even in the same person at different times, and in different stages of the affection. The varieties in different persons depend chiefly on the size and figure of the stone, on its smoothness or roughness, on the nature of the stone, the quality of the urine, and, when other things are equal, on the condition of the bladder. A small stone occasions less pain than a large one, and one that is smooth on the surface less than one that is rough, the rough nodules irritating the mucous membrane; and this is the reason why the mulberry calculus in most instances causes so great pain. But of all the calculi none are so painful as the phosphatic, which is no doubt owing to the greater degree of derangement of the general health, and to the general and local susceptibility being morbidly increased. An unusually acid or alkaline condition of the urine will increase the sufferings of the patient, the fluid being in each case too stimulating for the lining membrane; but the greatest pain is experienced in an inflamed condition of the bladder,

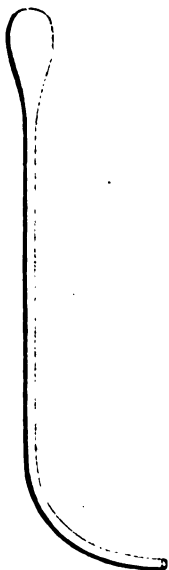
as the sensibility of the bladder is thereby greatly increased. The diathesis itself sometimes varies in the same person, and there is then a corresponding variation in the roughness or smoothness of the surface of the stone—changes which, apart from some of the facts stated above, sufficiently explain why the sufferings of the patient are so much greater at some stages of the concretion than at others.

SOUNDING.¹

Although a patient may have many or all of the rational signs of stone, nothing can positively convince the surgeon of its presence but feeling it with the sound.

A sound is an instrument made of polished steel, shaped somewhat like a catheter. The handle should be smooth, so as to communicate the most delicate impression to the fingers, and the point should be rounded, so as not to be arrested in the orifices of the prostatic or seminal ducts. The curve near the point should neither be too long, too acute, nor too obtuse, in order to facilitate the movements of the instrument when introduced into the bladder, and to bring it more accurately in contact with the stone.

Fig. 190.

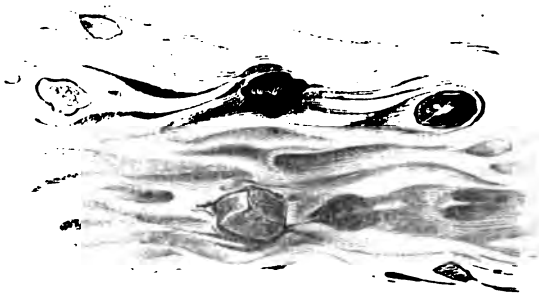


Previously to sounding, the bowels should be emptied by a dose of castor oil or an enema. A full rectum may impede the movements of the instrument, and impart deceptive sensations to the hand of the surgeon.

A patient is never sounded with an empty bladder. The patient should be directed to retain his urine, but should he have inadvertently passed it, the bladder is to be distended with three or four ounces of tepid water, injected through a silver catheter, which may then be used as a sound, care being taken to stop its orifice, to prevent the regurgitation of the fluid.

During the operation of sounding, the patient should be on his back, near the edge of the bed, with his shoulders elevated, and his limbs flexed, so as to relax the abdominal

Fig. 191.



muscles. The instrument is introduced in the same manner as a catheter.

¹ Condensed from Dr. Gross' work on Urinary Organs.

ter, and if the stone is not felt at once the sound must be rotated upon its axis, so as to explore every portion of the bladder. Sometimes the stone cannot be felt on account of its lying in a pouch in the *bas-fond* of the bladder, just behind the prostate gland. When this is the case the finger should be oiled, and introduced into the rectum, and the stone pushed upwards against the sound. It may be necessary to change the position of the patient, making him lie on his side, sit or stand, bend forward, or raise his buttocks. The stone may be contained in the folds of the bladder, or some abnormal pouch; or it may be adherent to the walls of the bladder. Small stones have been found imbedded in the parietes of the bladder. Several such calculi are represented in the accompanying figure.

The calculous matter, instead of being collected into a distinct concretion is sometimes spread out in the form of a layer upon the *bas-fond* of the bladder. The crust varies in thickness, and is sometimes difficult to break. It grates under the sound, and when struck emits a peculiar noise, not unlike that of a cracked pot. But the noise produced by striking a free calculus is a *click*, or a clear metallic resonance, which is more distinct when the stone is hard. The sense of touch is also readily impressed by the contact of the stone, and through it the volume of the calculus can be in some measure ascertained. There is danger in sounding patients who have travelled a great distance for surgical relief, before they have recovered from the fatigue. Cystitis and peritonitis may result to such an extent as to endanger the life of the patient.

The sounding should always be conducted with the utmost gentleness, and should never be continued beyond a few minutes at a time. A protracted operation of this kind is generally productive of mischief, and cannot be too pointedly condemned. Should severe pain ensue, it must be allayed by a full anodyne; and any inflammatory symptoms that may arise are to be combatted by the usual remedies. In all cases the patient should be directed to make free use of demulcent drinks.

"Although sounding is the only certain method of detecting a stone in the bladder, it is occasionally liable to error. Numerous cases are upon record where a foreign body was supposed to be present, and where the poor patients were subjected to all the pains and perils of lithotomy, and yet no calculus was found, either at the time of the operation or after death. Surgeons of the most consummate skill and the most extensive experience have fallen into this error. It is for the purpose of avoiding a repetition of such mistakes, so discreditable to those who commit them, that I shall endeavour briefly to point out their sources. Great men may sometimes commit an error with impunity which would bring ruin and disgrace upon a more humble member of the profession. Cheselden,¹ the most celebrated lithotomist of his age and country, cut three patients without finding any stone. Blanc,² Dupuytren,³ Roux,⁴ and Crosse,⁵ all operated, expecting to find

¹ Benjamin Bell's *System of Surgery*, ii. p. 40. Edinburgh, 1784.

² Desault's *Chirurgical Journal*, translated by Goeling, i. p. 125. London, 1794.

³ *Leçons Orales*, T. ii. p. 384.

⁴ *Johnson's Medico-Chir. Rev.*, April, 1827, p. 549.

⁵ *Essay on Urinary Calculus*, p. 50.

a stone, where there proved to be none. The late Dr. Physick¹ came very near committing the same mistake. He sounded a patient, and had no doubt there was a stone. His health, however, was bad, and the operation was postponed. He died some time after, and upon examination no stone was found.

"Mr. Crosse,² who, as we have just seen, was himself unfortunate in one instance, states that he has notes of not less than eight cases in which the operation was needlessly performed, and to several of which he was an eye-witness. The late Mr. Samuel Cooper,³ of London, was acquainted with the particulars of at least seven such cases, at two of which he was present. Velpeau⁴ says he has a knowledge of four instances, where the patients were subjected to the operation without there being any calculi in the bladder. South⁵ mentions the case of a child, two years and a half old, who was cut for stone, but in whom no stone was found, although he had suffered very severely, and a calculus was supposed to have been felt. I am acquainted with two instances in which the patients were lithotomized without there being any stone. One of these was a child, under four years of age, whose parents resided in Indiana. He was sounded several times, and a stone was supposed to be present, but none was found at the time of the operation. He recovered quickly, and is still living. The other case occurred in Kentucky, in an old man, upwards of sixty years of age, who was cut by the same surgeon, under the supposition that he had calculus. He died a few days after the operation, and, upon examination, the bladder was found to contain nothing but a fungous tumour, portions of which had repeatedly come away by the urethra during life. Many similar examples are recorded in the '*Mémoires de l'Académie de Chirurgie*' of Paris. It is worthy of remark, that quite a number of the patients in whom no stone was found were promptly and entirely relieved of the symptoms which had been attributed to its presence. On the other hand it is equally certain that some of them perished from the effects of the operation, while others who survived it received no benefit from it.

"The circumstances which may lead to the commission of the error above mentioned differ very much in their character, and are dependent for their origin either upon the bladder itself, or upon the surrounding parts. The following are the most important.

"I. In the first class are included an indurated and contracted state of the bladder, the development of an osseous cyst, and the formation of a fibrous, encephaloid, or polypus tumour, and a deposit of tubercular matter.

"II. In the second division of the subject may be comprised certain affections which involve the parts in the immediate vicinity of the bladder, as the prostate gland, rectum, uterus, vagina, and pelvic bones."⁶—Ed.]

Treatment.—Of the various modes of treatment recommended for the

¹ Liston's Practical Surgery, by Norris, p. 810. Philad., 1838.

² Essay on Urinary Calculus, p. 50.

³ Dictionary of Surgery, vol. ii. p. 184. New York, 1842.

⁴ Velpeau, Operative Medicine, vol. iii. p. 891.

⁵ Chelius's Surgery, South's Edition, vol. iii. p. 277.

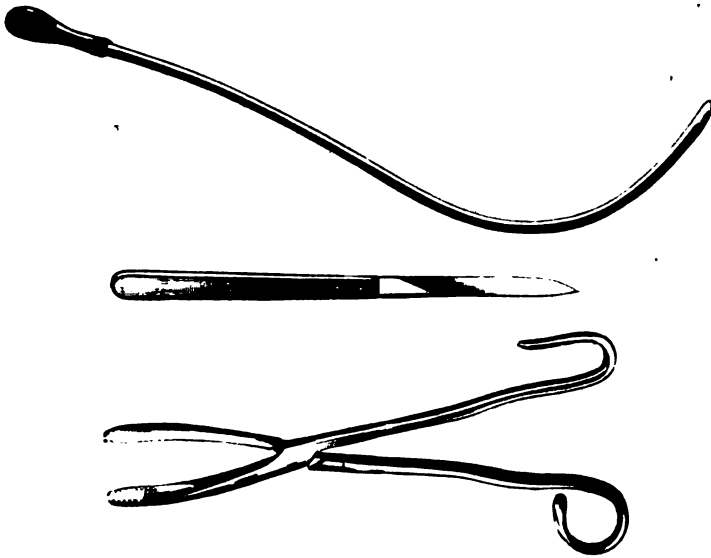
⁶ Dr. Gross, on Diseases and Injuries of the Bladder, p. 380-384.

removal of calculus, we shall refer to three, Lithotomy, Lithotrity, and Lithotripsy.

LITHOTOMY, OR CUTTING FOR THE STONE.

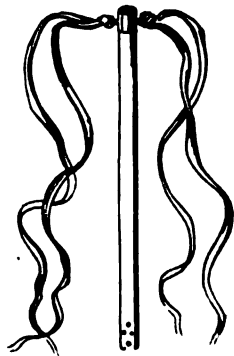
In the next section, which gives the history of Lithotomy, will be found the various modes in which the operation has been performed. Of these (several of which are not now in the list of regular and established operations), that which is to be preferred in almost every instance in

Figs. 192-195.



which lithotomy is justifiable, is the lateral operation. The several acts of this operation are variously performed; but the method of the late lamented Mr. Liston, who, while he lived, was deservedly regarded as the first lithotomist, has brought it to a state of the greatest simplicity and elegance, and has been adopted by the great majority of operating surgeons.

The perinæum having been shaved, the rectum having been cleared by a dose of castor oil on the evening before, and an injection on the morning of the operation,—the patient, having retained his urine from half an hour to three quarters of an hour previous to the operation, should be brought under the influence of chloroform, and then a staff of the largest size the urethra will admit, having a deep groove between its convexity and left side, should be introduced, and the stone having been felt, the charge of the staff should be given to the principal assistant. The hands and feet of the patient should be tied to each other,



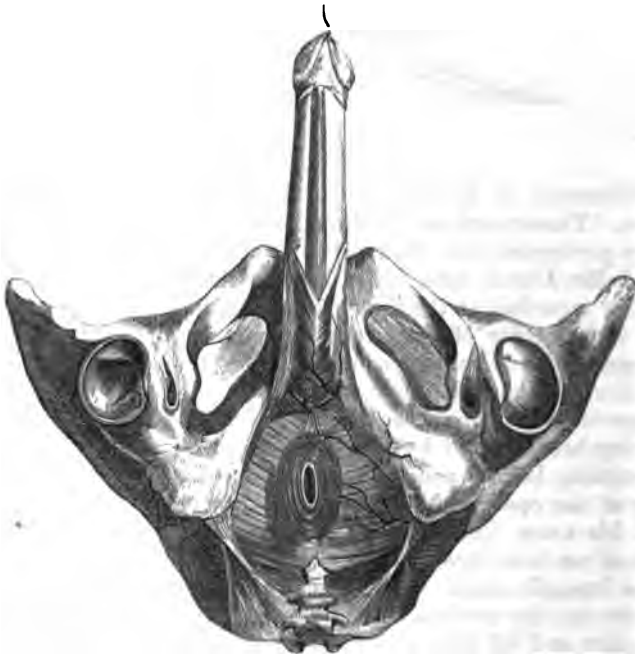
and his body placed in the attitude shown by the accompanying drawing. If the staff be of the largest size that can be conveniently introduced,

Fig. 196.



it will be easily felt after the first incision, and the urethra can without difficulty be opened upon it. The staff should be drawn up under the pubes to keep the prostate gland from being imbedded in the rectum, and held steadily by the assistant in that position throughout the diffe-

Fig. 197.



rent stages of the operation. The operator should then introduce the fore-finger of the left hand into the rectum to make sure of its being

empty, and to excite it to contract, which will diminish the risk of its being injured during the operation. I have always followed the example of Mr. Liston in making the introduction of the finger into the rectum the last thing before the commencement of the operation, in order to diminish the danger of its being wounded, and the first thing after its completion, to make sure of its being safe. The first incision is then made by introducing the knife pretty deeply into the perinæum at the left side of the raphé, and about an inch in front of the verge of the anus, and by carrying it downwards and outwards to rather more than an inch below the anus, and so directing it that the middle of the incision may be about midway between the anus and the tuberosity of the ischium. By this means the skin and superficial fascia are divided. The fore-finger of the left hand is then pressed into the middle of the wound for the purposes of putting aside cellular tissue and thereby enlarging the wound, of keeping the rectum out of harm's way, and of feeling for the staff in the membranous portion of the urethra. Such fibres of the transversus perinei and levator ani muscles as oppose the onward progress of the finger should be carefully divided by the knife. The groove of the staff is easily felt anterior to the deep fascia of the perinæum. The point of the nail of the fore-finger should be pressed against the groove, and the knife, carried along the back of the finger, should be made to enter the groove about three lines in front of the prostate; and it having been surely ascertained that the knife is in the groove of

Fig. 198.



the staff, it should be cautiously pressed backwards so as to divide that portion of the membranous part of the urethra which is posterior to where the knife enters the groove, the deep fascia and fibres contained within it, the prostatic portion of the urethra, the left lobe of the prostate gland, and the dense unyielding fibrous band at the base of the prostate, into which the muscular fibres are inserted. The incision should commence about three lines in front of the gland, and should not extend beyond its circumference, so that there may be no risk of the

ilio-vesical fascia being divided, as such division would admit of infiltration by breaking up the barrier which this fascia constitutes between the external and internal cellular tissues. The edge of the knife should be directed downwards and outwards. If it be held too horizontally, the section of the prostate, so made as not to extend beyond its base, would be too limited, and the planes of the external and internal incisions would not correspond: if too vertically, the section obtained would also be too limited, and the rectum would be endangered. The finger should be so placed as to protect the rectum, and should follow the knife, which is withdrawn as soon as the incision has been made, and immediately afterwards the principal assistant withdraws the staff, the surgeon re-

Fig. 199.



taining his finger in the section of the prostate. In most instances the stone can be felt with the front of the finger; the forceps should then be introduced, the finger being used as a guide. When the forceps reaches the stone, its blades should be opened, the stone seized, and efforts made to extract it, the handles of the forceps being depressed so that the line of extraction may be in the direction of the axis of the pelvis, and the fore-finger of the left hand preventing the descent of the bladder with the stone and forceps. To make the external incision free, facilitates the remaining steps of the operation: but the internal incision should be limited;—the great object being to avoid cutting beyond the circumference of the prostate, so that the ilio-vesical fascia, which is the barrier between the external and internal cellular tissues, may be

entire. The prostate, the mucous coat and muscular fibres at the neck of the bladder are so yielding that the wound can be easily dilated without any laceration, and thus a stone of very considerable size can be readily extracted through an incision of very limited extent, perhaps not more than seven or eight lines in length, and not extending into the bladder beyond the base of the prostate. If the stone should be too large to be safely extracted through the limited opening now described, the most judicious course then is to introduce a probe-pointed bistoury along the finger, and effect a similar incision on the right side of the prostate; in short, to make what is called the bilateral section of the gland—a proceeding which may be adopted from the first, if it is certain that the stone is too large to be extracted through a section on one side of the prostate gland.

It having been ascertained by the appearance of the stone, or, if necessary, by the use of the searcher, that there is not another calculus, the elastic tube is introduced into the wound to facilitate the escape of the urine, and thereby to diminish the danger of infiltration; and for the promotion of the same object, the patient after being removed to bed, is placed on his back with his shoulders a little raised. Such is the simple and safe mode of performing lithotomy with the knife, recommended by Mr. Liston, and which I often witnessed with the greatest admiration when I was his pupil.

[Many operators prefer a probe-pointed knife. Dr. Gross employs a probe-pointed bistoury closely resembling that of Blizard.—ED.]

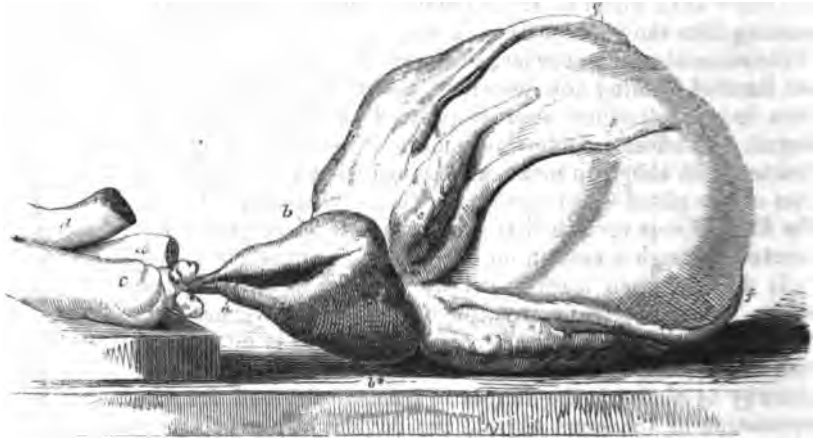
The structures divided in this operation are the integument, two sets of fasciæ, namely, the superficial fascia and the two layers of the deep fascia; the transverse muscle of the perineum on the left side, some of the fibres of the levator ani, and the muscular fibres between the two layers of the deep fascia; the external hemorrhoidal arteries, and the transverse artery with their associate veins and nerves; the cellular and adipose tissue in the ischio-rectal excavation; a few lines of the back part of the membranous portion of the urethra, the prostatic portion of the urethra, the left lobe of the prostate gland, and the dense, unyielding, fibrous band at the base of the prostate, into which the muscular fibres are inserted. If the incisions are properly arranged, the above are the only structures that will be interfered with. The principal dangers to be guarded against are, bruising the soft parts, wounding the rectum, wounding some important artery, as the artery of the bulb, and too extensive division in making the section of the prostate. The precautions to be adopted for avoiding the first and second of these dangers have been mentioned; the third is avoided by not commencing the incision too high up: and the fourth by limiting the extent of the incision so as not to cut the bladder beyond the circumference of the prostate. Some arteries occasionally deviate from their usual arrangement, and are then in danger of being wounded. The artery of

Fig. 200.



the bulb occasionally arises from the pudic near the tuber ischii, and crosses the line of incision. Should it be wounded, it ought if possible to

Fig. 201.



be secured by a ligature. The pudic artery, even when presenting that abnormal arrangement in which it lies on the posterior edge of the prostate, would be wounded only if the incision reached beyond the gland;—an additional reason to that already given for limiting the extent of the section. In old persons there is sometimes venous hemorrhage from the veins around the prostate, which often become enlarged at an advanced period of life. This is most efficiently arrested by pressing some plugs of lint around the tube; and the same plan is adopted in the case of arterial hemorrhage, when it is difficult to find the artery, and the hemorrhage does not cease on the thighs being brought together, which, however, it often does from the opposite sides of the wound being then more closely pressed against each other. In the event of lint being introduced, it is necessary to be even more than usually careful that the tube be kept completely pervious.

The principal object of the tube being to prevent urinary infiltration, it is retained until it is reasonable to suppose that the cells of the cellular tissue are closed by effusion of lymph. In young persons, twenty-four hours will be sufficient for this purpose, the process of effusion being rapid at that period of life; but in persons of a more advanced age, or of a relaxed habit of body, it should be retained for at least forty-eight or fifty hours; and the greatest care taken for the first few hours after the operation until the urine become colourless, to observe that occlusion of the tube be not produced by coagulated blood. The important objects

[Fig. 201. This engraving, copied from Scarpa, represents the left lobe of the prostate as it is divided in the lateral operation. *a*, Marks the incision of the membranous portion of the urethra and the side of the gland. *b*, The left lobe of the prostate. *b'*, The right lobe of the organ. *c*, The bulb of the urethra. Close behind are observed Cowper's glands. *d, d*, The legs of the penis. *e, e*, The seminal vesicles. *ff*, The deferent ducts. *g*, The ureter of the left side.—Ed.]

of attention for the first few hours are, that there be no hemorrhage, that the tube be pervious, and that the urine-flow plentifully, and gradually become colourless. The secretion having become colourless, and no particular constitutional sympathy having manifested itself, the early and principal dangers are passed. On the withdrawal of the tube, the wound may be dressed with a little lint, and subsequently with a little lint dipped in oil, resinous ointment or turpentine liniment, according to the particular state of the granulations. In many instances no application whatever is required. The greatest care should be taken to keep the nates free from inflammation and excoriation by the use of the spirit lotion, lard, and the frequent change of sheets, so as to keep the parts as dry as possible; the mind should be encouraged, the strength kept up by all means which in the particular circumstances of the case would be judicious, the frequent error of keeping the patient too low avoided, and the constitutional treatment in other respects conducted according to the common principles of surgery. In the course of eight or ten days a little urine comes by the urethra, generally causing a slight pain and irritation the first time, and the patient seldom feels so well for that day; the quantity gradually increases, and in three or four weeks, sometimes more and sometimes less, the whole comes by the urethra, and the continuity of the parts is restored by the healing of the wound after which the treatment proper for the diathesis should be continued, as reproduction of stone occasionally though very rarely occurs.

[With regard to the result of the operation, Dr. Gross states, "It has been calculated that about one patient out of every five that are cut for stone by the lateral method perishes: and this estimate, taking the general average results, is, perhaps, pretty near the truth. Considered, however, with reference to individual operators, it is incorrect. Thus, taking the results furnished by some of our own lithotomists, it will be found that they afford a much more gratifying picture. Dr. Dudley, for instance, is said to have lost only 5 cases out of 180 cut, up to the beginning of 1846; Dr. Mettauer, of Virginia, 2 out of 78; Dr. John C. Warren of Boston, 2 out of 30, of which three, however, were by the bilateral method; and Dr. Gibson of Philadelphia, 6 out of upwards of 50. My own cases, amounting to 24, have all been successful. I invariably use the knife; while Dudley and Gibson employ the gorget. In the Pennsylvania Hospital, at Philadelphia, between 1752 and 1848, 83 cases of stone were cut by the lateral method, and except in a few instances of very young children, by means of the gorget. Of this number 72 were cured, and 10 died; 1 being set down as relieved."—Ed.

HISTORICAL SKETCH OF PERINEAL LITHOTOMY, AND THE VARIOUS MODES OF OPERATING.

THE METHOD OF CELSUS.

This mode of operation, the most ancient on record, and the only one in use down to the sixteenth century, deriving its name of *Lithotomia Celsiana* from having been described by Celsus, has also been called

¹ Dr. Norris's Report on Surgery, Trans. Amer. Med. Assoc., vol. i. p. 168.

cutting on the gripe, and, the operation by the apparatus minor, on account of the fewness of the instruments required,—a knife and a hook, and sometimes only a knife having been used.

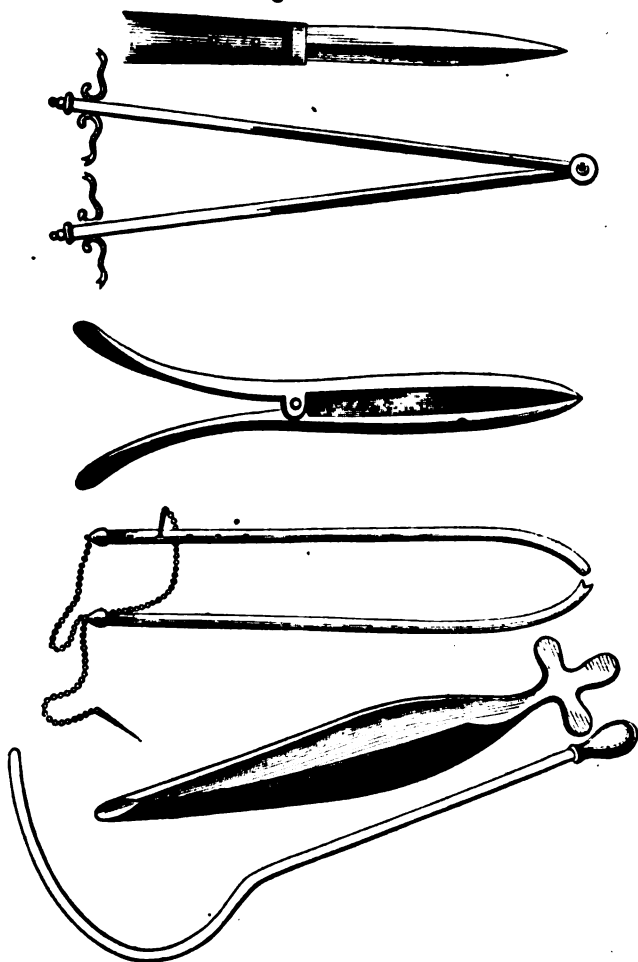
The rectum having been emptied by means of a clyster, and the patient having walked about the room to bring the stone down to the neck of the bladder, he was placed in the lap of an assistant, whose duty it was to hold him, and to keep the thigh bent and separated so as to expose the perineum. Sometimes, if the patient was not a young person, two assistants were strapped together by the thighs to support him between them, each having charge of a thigh. The operator, having oiled his fingers, introduced the index and middle fingers of the left hand into the rectum, and endeavoured to get them behind the stone, to force it forwards to the neck of the bladder, and to make it cause a prominence in the perineum. A lunated incision was then made, having its convexity forwards to the bulb of the urethra and its concavity backwards to the anus, the extremities being directed to the ischia. The words of Celsus, "*cornibus ad ischia spectantibus*," show that those writers are mistaken who say that the extremities of the incision were directed to the left hip. The parts between the middle of this incision and the stone were cut through, and the operator then endeavoured to press the stone through the wound, or to extract it by means of a hook.

THE OPERATION BY THE APPARATUS MAJOR.

The next operation we read of in the history of perineal lithotomy is known by the names of the operation of Johannes Romanus, by whom it was devised,—the Marian operation or the Sectio Mariana, in consequence of a minute description of it having been given by Marianus Sanctus, a pupil of Johannes Romanus,—the operation by the apparatus major, from the multiplicity of instruments employed (*l'opération par le grand appareil*, Fr.), and median lithotomy, from the first incision having been made in the mesial line in the perineum. The reason assigned for the introduction of this mode, and the abandonment of that previously in use, was the declaration of Hippocrates that "wounds of membranous parts are mortal." It was supposed, however, that such parts might be dilated with safety, and it was on the principle of dilatation that the operation was founded. The patient having been placed on a table with his shoulders raised, his hands were bound to his feet, and the latter were separated from each other, drawn upwards, and still more firmly fixed by turns of a bandage passed round his neck and shoulders; and in this attitude he was held by assistants. A grooved staff was then introduced into the bladder, and an incision made with a razor in the middle line of the perineum extending from behind the scrotum to near the verge of the anus; by the further application of the knife the bulbous portion of the urethra was opened; and this was all the cutting employed in the operation. The operator having the point of the knife lodged in the groove of the staff, introduced a probe into the bladder, guiding it by the knife into the groove, and by the staff into the bladder. The knife and staff having been withdrawn, the instruments for dilatation were then used. These were two, called the male and female conductors. The female conductor, which was a long director with a groove, was introduced along the probe, when the latter

was withdrawn, and the point of the male conductor having been placed in the groove of the female, was pressed onward into the bladder. The lithotomist then, by taking the extremity of a conductor into each hand,

Figs. 202—207.



and separating them from each other, commenced the work of dilating, or rather tearing up the membranous and prostatic portions of the urethra and the neck of the bladder. After all the dilatation that could be effected by the conductors had been accomplished, the grand forceps was introduced between them into the bladder, and employed first in still increasing the dilatation, and then in seizing and extracting the stone. After Marianus, who gave the first description of the operation, his successors contrived many other instruments to be used after the male

Figs. 202—207. "Instruments constituting the "Apparatus Major.""

and female conductors, in tearing open the neck of the bladder. The principal of these were the gorget of those days, which was in use in the time of Collot, though its employment was not patronised by him; the simple dilator, which dilated by its handles being brought together; the dilator of some authors, an entirely different instrument; and the double dilator. By some or other, or all of the above-mentioned instruments, together with the fingers of the operator, the membranous and prostate portions of the urethra, prostate gland, and neck of the bladder, were torn open to make room for the extraction of the stone. The cruelties of this operation could scarcely have been exceeded; but although its results were such as might have been expected, it was still practised from 1520, when it was first proposed, to 1697, when Frère Jacques de Beaulieu taught the surgeons of Paris to despise it, and proposed another mode of operation.

Some of the most celebrated operators with the grand appareil, were Marianus, Paræus, the family of the Collots, who were Lithotomists to the kings of France for several generations (the elder Collot having been appointed Royal Lithotomist to Henry II., and having been the first person on whom that title was conferred), Octavius de Ville, Toletus, and Mery and Marechal, the surgeons-in-chief to the Hôtel Dieu and La Charité Hospitals in Paris.

OPERATION OF FRÈRE JACQUES.

Frère Jacques, a native of Langsauniere, in Burgundy, devised a method of cutting for the stone, which shall presently be described. Having practised this method with success in various towns on the Continent, he went to Paris, where he had influence enough to obtain from President Harley an order to perform his operation on a dead body in the Hôtel Dieu in the presence of the surgeons of Paris. Mery, surgeon-in-chief of the hospital, was required to report regarding it.

On the 7th of December, 1697, Mery received the first order to witness Frère Jacques cut a dead body for the stone in the Hôtel Dieu, and on this experiment he gave a most favourable report. On the 14th of the same month he received a second order from the president to witness Frère Jacques make further trials of his operation on dead bodies in the Hôtel Dieu; and it is remarkable that Mery, who indeed is supposed to have been influenced by the violent jealousies entertained towards Frère Jacques by the lithotomists and surgeons of the day, and to have become the organ of their party, reported in opposite terms of these further experiments, and condemned what previously he had strongly praised. In consequence of this, Frère Jacques lost the support of President Harley, and being dispirited, left Paris without being allowed to perform his operation on the living body. He went to Fontainebleau, where he was introduced to Daschene, one of the physicians to the court; to Bourdelot, physician to the Duchess of Burgundy; to Fagon, physician, and to Felix, surgeon to Louis XIV.: and by the influence of these gentlemen an order was given by the court, that he should perform his operation on a boy from Versailles, then living at Fontainebleau, who was afflicted with the stone. He performed the operation in the presence of the above-named gentlemen, and in a manner to com-

mand their admiration, and in three weeks the boy was seen running in the streets perfectly well. The consequences were, that Frère Jacques cut six other persons at Fontainebleau, gained the favour of the court, and the enthusiasm of the people, and returning to Paris, and there operating in private on twelve persons, produced such an impression on the public mind, that President Harley summoned a meeting of the physicians, surgeons, and managers of the Hôtel Dieu, together with the magistrates of Paris, and others, at the palace of the archbishop, on the 7th of April, 1698, requiring another report on this operation. The contest at this meeting is said to have been very violent. The operators by the apparatus major finding that all they had been proud of in their method was in danger, with themselves, of falling into neglect, were as strong in their opposition to the new mode as the friends of Frère Jacques were in their approval of it; but the final result of the discussion was, that the latter were triumphant, and it was resolved that, in the ensuing season of cutting for the stone, Frère Jacques should be allowed to perform his operation in the Hôtel Dieu and at La Charité. He operated accordingly, but unfortunately for him, of sixty-two patients whom he cut in those hospitals, twenty-five died, seven having been carried dead out of La Charité in one day. This occasioned the renewal of the persecution which had before been directed against him, and it was now carried on not only by the lithotomists and surgeons, but also by the priests, whose violent hatred he had incurred by accusing them of having poisoned his patients and injured their wounds for the purpose of bringing discredit on his operation. A second time therefore he left Paris, but continued to practise his operation in the chief towns of France, in Holland, and in Germany, to the great admiration of those who witnessed his proceedings. Up to this period of his career Frère Jacques was perfectly ignorant of anatomy: he was not aware of the danger of wounding parts, the structure of which was unknown to him: and hence he had all the boldness of a man unconscious of danger. In the operation hitherto practised by him, called, in the history of his proceedings, his original uncorrected operation, he introduced into the bladder a large peculiarly-shaped staff, without a groove, and holding it with his left hand, he with the right plunged a long dagger-shaped knife along the side of the tuber ischii of the left side into the bladder; having made a sufficiently large opening, he next introduced into the bladder a conductor through the wound, and having carried a forceps along the conductor into the bladder, he then withdrew the conductor and staff, and endeavoured to extract the stone. The staff, as we have already stated, had no groove, nor was it used to guide the knife into the bladder.

Fagon, the king's physician, was deeply impressed with the boldness with which Frère Jacques performed his operation, and being himself afflicted with the stone, he formed the resolution of allowing Frère Jacques to operate on himself; and partly perhaps with that view, and partly from admiration of his boldness and benevolence, he invited him to return to Versailles, and kindly inducing him to live in his house, persuaded him to study anatomy, and to make dissections under the direction of the celebrated Du Verney. Frère Jacques operated on the dead body, and the parts were then dissected by Du Verney, who, to-

gether with Fagon and Felix, the king's physician and surgeon, pointed out to him the dangers against which he had to guard; and the result was that they induced him to perform what is called his second, or improved operation, which differed from the former in the use of a grooved staff for conducting the knife into the bladder. This operation he practised on the dead body, in the presence of his three friends, until Du Verney pronounced his experiments on the dead body perfect; and his success on the living body was such that he at one time cut thirty-eight persons without losing a single patient. Such is the history of Frère Jacques's improved method, which has always been considered as the foundation of the very superior mode of perineal lithotomy practised in the present day.

A celebrated writer gives the following account of an event which occurred about this part of Frère Jacques's career, and exercised great influence on public opinion with reference to his operation.

"There were at this moment two men of eminent rank who had resolved to submit to the operation of Frère Jacques; the one, Mr. Fagon, first physician to Louis XIV., the other the Maréchal de Lorges; both had taken measures to insure the success of the operation; but in the very moment that Frère Jacques was about to obtain the most distinguished honour, he suffered a sad reverse of fortune. Mr. Fagon had himself taught Frère Jacques, and with the assistance of Du Verney, the celebrated anatomist, and Felix, first surgeon to the king, had made him go through a series of dissections. His operation was reformed according to their desire; he had forsaken his big round staff, and cut upon a grooved one; he had operated on thirty patients in the Hôtel Dieu of Versailles with uninterrupted success; he had already sounded Fagon, and felt the stone; yet Fagon, though thus far advanced in this generous design, was prevailed on, by the solicitation of his friends, to put himself into the hands of Maréchal, who had learned to perform Frère Jacques's operation. Maréchal accordingly performed the operation, and Fagon survived, and in a few weeks went abroad in his carriage. The Maréchal de Lorges, of distinguished rank and great fortune, proceeded with equal precaution; he assembled in his hotel twenty-two poor people afflicted with the stone, who were cut by Frère Jacques with perfect success: but while the poor patients survived, the Maréchal himself died in tortures the day following the operation. This was decisive of the fate of our operator. The Maréchal de Lorges lying dead in his superb hotel, while Fagon, cut by Maréchal, was rolling in his chariot in the streets of Paris, was a triumph for the regular lithotomists, and a mortal blow to the reputation of Frère Jacques, who now departed from Paris never to return."

Frère Jacques operated on nearly five thousand patients in all; he was benevolent, candid, and disinterested; he never accepted more money for his services than was necessary to mend his shoes and to sharpen his instruments. He operated with astonishing success in different parts of France; also at Amsterdam, where he was presented with a gold medal for his public services; at the Hague, where he received a present of gold sounds, which it is said he afterwards had melted to give to the poor: and at Delft, Leyden, Padua, and many other places; after

which he went to Rome to receive the benediction of the Pope, and then returning to his native village, at an advanced period of life, he distributed among the poor what little money he possessed, and died, according to Morand, in June, 1714.

RAU'S OPERATION.

Rau, Professor of Anatomy at Leyden, and teacher of the celebrated Albinus, was the next great lithotomist that appeared. He had seen Frère Jacques operate, and had himself operated with great success; but he refused to tell any one his mode of proceeding, and died without leaving any description of it. From the account which Albinus gives of it, it is believed that its peculiarity consisted in cutting into the bladder behind the prostate, and dividing the prostate by cutting from behind forwards, instead of (as in Frère Jacques's improved operation) from before backwards. In this proceeding, a grooved staff was used.

CHESelden's OPERATION.

The celebrated Cheselden, surgeon to St. Thomas's Hospital, London, being deeply impressed with the success of the operations of Frère Jacques and Rau, resolved to abandon hypogastric lithotomy, or, as he called it, of cutting into the bladder by the highway, and to perform perineal lithotomy. From Cheselden's own description of his proceedings, contained in the appendix to different editions of his "Anatomy," and from the account of the operation as he at one time practised it, given by Douglas, who states that he received it from Cheselden himself,—it is perfectly clear that when he first practised perineal lithotomy, after making his incision in the perineum, he endeavoured to cut into the under part of the lateral region of the bladder, and then fixing his knife in the staff, he divided the prostate gland, and neck of the bladder from behind forwards. This method, however, he afterwards abandoned, as being not only difficult of performance, but also unsuccessful, chiefly from sloughing and infiltration of the cellular tissue.

Cheselden's second operation has been uniformly regarded as superior to any adopted before his time; and, indeed, with slight modifications, it is nearly the same as that practised by most of the best lithotomists at the present day. On this subject, the lamented Mr. Liston wrote, as his deliberate opinion,—and, in former days, when I had the great privilege of being his pupil, I repeatedly heard him make the same statement,—“Depend upon it that, somewhat modified, it is the best operation that can be performed; it is one I have practised with little alteration for many years, and in not a few cases, and I see no reason to change it for any other.” The following is Cheselden's account of his second operation, as I find it given by him at page 330, of the thirteenth edition of his work on Anatomy now before me.

“I first make as long an incision as I can, beginning near the place where the old operation ends, and cutting down between the musculus accelerator urinæ and erector penis, and by the side of the intestinum rectum. I then feel for the staff, holding down the gut all the time, with one or two fingers of my left hand, and cut upon it in that part of the urethra which lies beyond the corpora cavernosa urethræ, and in

the prostate gland, cutting from below upwards, to avoid wounding the gut; and then passing the gorget very carefully in the groove of the staff into the bladder, bear the point of the gorget hard against the staff, observing all the while, that they do not separate and let the gorget slip to the outside of the bladder; then I pass the forceps into the right side of the bladder, the wound being on the left side of the perineum, and as they pass, carefully attend to their entering the blad-

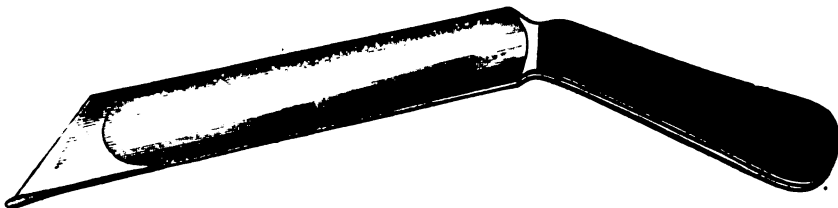
Fig. 208.



der, which is known by their overcoming a straightness which there will be in the place of the wound; then, taking care to push them no further that the bladder may not be hurt, I first feel for the stone with the end of them,—which having felt, I open the forceps, and slide one blade underneath it, and the other at top; and if I apprehend the stone is not in the right place of the forceps, I shift it before I offer to extract; and then extract it very deliberately, that it may not slip suddenly out of the forceps, and that the parts of the wound may have time to stretch, taking great care not to gripe it so hard as to break it; and if I find the stone too large, I again cut upon it as it is held in the forceps."

Cheselden's success was very remarkable; on this point, he says, "What success I have had in my private practice, I have kept no account of, because I had no intention to publish it, that not being sufficiently witnessed. Publicly in St. Thomas's Hospital, I have cut two

Fig. 209.



hundred and thirteen; of the first fifty only three died: of the second fifty, three; of the third fifty, eight; and of the last sixty-three, six. Several of these patients had the small-pox during their cure, some of whom died, but I think, not more in proportion than usually of that distemper; these are not reckoned among those who died of the operation. The reason why so few died of the first two fifties was, at that time few

bad cases offered; in the third, the operation being in high request, even the most aged and most miserable cases expected to be saved by it, and besides, at that time I made the operation lower, in hopes of improving it, but found I was mistaken."

SIR CÆSAR HAWKINS'S MODE.

The next important change in the mode of proceeding among the surgeons of this country was that introduced by Sir Cæsar Hawkins, surgeon to St. George's Hospital, who, having an edge put upon the blunt gorget of the apparatus major, thereby converted it into a cutting gorget; and after cutting with the knife into the membranous portion of the urethra, he effected an opening into the bladder by dividing the prostate with the gorget. After this method became known, many different forms of gorget and gorgerets were invented; which it would answer no useful purpose to describe. Of one of them, Mr. Liston remarks, "It is more like an implement for cutting turf,—a 'flaughter-spade,'—than for performing a delicate surgical operation." Of other instruments invented for dividing the prostate, and cutting into the bladder some of the most celebrated were the bistouri cachée of Cosme; the gorgeret cistotome-dilatatoire-composé of Le Cat; and the double lithotome, used by Dupuytren, in his bilateral section.

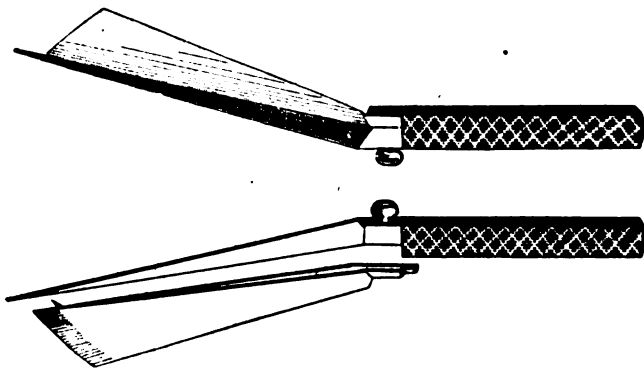
"The gorget is fast falling into desuetude. Whether this is owing to any intrinsic defect in the instrument itself, or merely to the manner of using it, cannot be easily determined. However this may be, very few operators, either in this country or in England, continue to employ it. Dr. Dudley, of Lexington, has performed all his operations, upwards of two hundred in number, with it; and I am told that he still uses the same instrument with which he commenced his brilliant career as a lithotomist, forty years ago. Dr. Gibson, of Philadelphia, also adheres to the gorget, and so do likewise a few of the other surgeons of that city. Most American operators prefer the knife, which is also the case in England, France, and other portions of continental Europe. The gorget has undoubtedly committed many blunders, the recital of which would form one of the most sickening chapters in the history of surgical wrongs. Nevertheless, it has done, and still continues to do, good service in the hands of some of our most eminent men, and ought not, therefore, perhaps, to be spoken of too lightly or severely, for its faults are, perhaps, after all, rather attributable to the surgeon than to the dumb instrument with which he does his bungling work.

"The gorget has sometimes slipped into the cellular tissue between the bladder and the rectum, or between this organ and the pubes; thereby bruising and otherwise injuring the parts, and favouring the occurrence of urinary infiltration. Cases are mentioned, where, by a blind and heroic thrust, the instrument completely severed the bladder from its connexions, pierced the rectum, or penetrated the peritoneal cavity, and passed high up among the bowels. Mr. John Bell, in his History of Lithotomy, says, 'I have seen the gorget driven twice, not into the bladder, but deep among the bowels; for although there was a stone, the surgeon never reached the bladder. Not one drop of urine followed; the stone was not extracted; and the boy died the second day

from the operation.' Sir James Earle observes that he has more than once known this instrument, though passed in the right direction, pushed on so far, and with such violence, as to go through the opposite side of the bladder. Mr. Benjamin Bell found in two instances, on dissection, that this organ was wounded in three different parts, at its neck, in its side, and towards its superior fundus. The late Mr. Crosse states that he has repeatedly seen the gorget slip between the bladder and the rectum; in one instance he declares that the instrument, after entering the bladder, pierced its coats from within outwards, so as to stop against the pubic bone. Bromfield, in passing the gorget, perforated the opposite side of the bladder, and found, to his horror, on withdrawing the instrument, that the intestine had descended through the opening. The bowel had to be held out of the way while he extracted two calculi, though it was forced out again by the child's screaming before he attained his object. 'As soon as he was convinced, by his finger, that the bladder was totally free from any pieces of stone, he again returned the intestine into the pelvis, and brought the child's thighs close together; a piece of dry lint was applied to the wound, and a pledget over it; he was then sent to bed with no hopes of his surviving till the next day; but, contrary to expectation, the child had a very good night, and was perfectly well in little more than a fortnight.' It is said that the celebrated Scarpa thrust the gorget, which was looked upon as the palladium of his fame, between the bladder and the rectum.

"The operation with the gorget differs, in no wise, in its early stages, from the operation with the knife. The period for using the instrument is immediately after the incision of the membranous portion of the urethra. The surgeon then exchanges the scalpel for the gorget, the beak of which he places in the groove of the staff, guided by the point of the left index-finger. After assuring himself, by drawing the instrument slightly backwards and forwards, that it is in no danger of slipping, he

Fig. 210.



takes hold of the handle of the staff, and by a simultaneous movement of his hands, he lowers the instrument and the gorget nearly to a level with the abdomen; pushing at the same time the latter onward into the bladder. In executing this part of the operation, care should be taken not

only that the gorget do not slip out of its place, and thus pass between the rectum and the bladder, but that it is properly lateralized, otherwise there will be great risk of injury to the rectum and the pudic artery. The annexed engraving represents the gorget, as modified and improved by Physick and Gibson." (From Gross on Urinary Diseases, &c.)—Ed.]

DUPUYTREN'S OPERATION.

Sectio-bilateralis.—The bilateral section of Dupuytren consisted in making a semilunar incision, having its convexity forwards, and extending from between the anus and the tuberosity of the ischium on the one side, to the corresponding part on the other; in continuing the dissection so as to divide all the parts over the membranous portion of the urethra, and opening this membranous portion for a short distance from before backwards; after which, the double lithotôme was fixed in the groove of the staff, and by it conducted into the bladder; then, the staff having been withdrawn, the concavity of the lithotome was directed downwards, the blades were expanded, and in withdrawing the instrument, the double section was effected. A double reason in favour of this proceeding is, that there is no risk of wounding the rectum, nor of injuring the pudic arteries, unless the blades be expanded to an unnecessary extent.

["The bilateral operation of lithotomy has never had any distinguished advocates in Great Britain, where the ordinary method seems to be universally preferred to all others. Nor has it, so far as I am informed, received much countenance in Germany, Russia, and Italy. It was first performed in this country in 1832, by Dr. Ashmead, of Philadelphia. It was repeated soon after by Dr. Ogier, of Charleston; and within the last ten years has been practised by Stevens, Warren, Mussey, Eve, Parker, Watson, Hoffman, Post, May, Pancoast, and other surgeons. It was also, as I am informed, the favourite method of the late Dr. Bushe, of New York. I have myself been so much wedded to the lateral method that I have never felt inclined to employ any other.

"Most of the surgeons above named use the knife, both for dividing the perinæum and the prostate gland. My distinguished friend, Professor Eve, of Georgia, who is one of the most able and strenuous advocates of the bilateral method, informs me that he always employs the lithotôme caché of Dupuytren. Of fourteen patients cut with this instrument, only one died, but from no cause connected with the operation. Dr. Stevens, of New York, has devised an instrument, named the *prostatic bisector*, which he uses for cutting the prostate gland and neck of the bladder. An instrument very much on the same plan had been previously contrived by Dr. Pattison and Dr. Bushe. Dr. Mussey, of Cincinnati, formerly employed the lithotôme caché, but of late years, as he has recently informed me, he has given a decided preference to the knife. The last twenty-three operations which he has performed were done in this manner.

"The double lithotôme was greatly improved by Dupuytren, and is accurately represented in the annexed drawing. 'It consists of two long, narrow blades, folding upon each other, and concealed in a

case, which is slightly curved, and adapted, by its size and shape, to be passed along the groove of the staff into the bladder. Thus, the instrument is introduced through the urethra without injury to the parts, while a mechanical contrivance attached to the handle allows the blades to be expanded after it has been lodged in the bladder. They quit the sheath on each side, and, when separated, resemble the blades of a pair of scissors with the cutting edges reversed. In this state the instrument is withdrawn, and cuts its way out. The size of the opening produced

Fig. 211.



of course depends upon the extent to which the blades have expanded, their degree of separation being indicated by an index.'¹ (Gross on Urinary Diseases, &c.)—Ed.]

It is hoped that from the preceding account may be clearly understood the mode of performing lithotomy adopted by some of the most distinguished surgeons of the present day, as well as the principal methods we read of in the history of the operation, and their most important varieties. Besides the median, lateral, and bilateral modes of perineal lithotomy, quadrilateral lithotomy has been proposed, in certain circumstances, by M. Vidal de Cassis, but it is unnecessary to describe this proceeding.

LITHOTRITY.

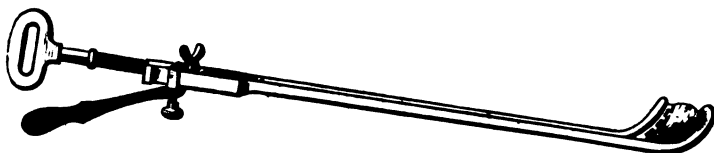
This term is now used to designate the operation of boring or rubbing a calculus in order to pulverize it, and so remove it through the natural passage. The first person in modern times who adopted proceedings with that view, was General Martin, who, in 1800, operated on himself, and, by means of a file, removed part of a stone with which he was afflicted. In 1813, Gruithuisen proposed the use of a canula through which a borer was introduced; and after him, several others who had devoted attention to the subject, made various suggestions, possessing more or less ingenuity. But M. Civiale, in 1823, proposed a more ingenious apparatus than any of his predecessors. This consisted of an outward canula containing three branches, which, when thrust out, after its introduction into the bladder, seized and held the stone, on which, when thus firmly fixed, a drill, sent through the inner canula, was made to act. The result, however, of this, and of all other proceedings on the same principle, was far from satisfactory, and, in consequence, the present practice is to crush the stone, instead of drilling it,—or, in other words, Lithotritry has been superseded by Lithotripsy.

¹ Brit. and Foreign Med. Rev., vol. ii. p. 101.

LITHOTRIPSY.

The operation known by this name, for removing calculi by crushing, has now been brought to great perfection. To the late Mr. Weiss, sen., undoubtedly belongs the merit of having invented, and offered to the profession, the first lithotripter, on the principle of that now in common use; and Mr. Weiss, jun., brought the instrument to its present state of great simplicity and perfection. On the recommendation of Mr. Liston, Mr. Weiss made the handle of metal, instead of wood or ivory, with which it had before been covered,—a change by which the perception of the contact of the instrument with the calculus is rendered much more delicate. At the suggestion, as Mr. Liston informs us, of Mr. Oldham, a gentleman connected with the Bank of England, Mr. Weiss introduced another most important alteration, without which the use of the instrument was more hazardous:—he made the outer blade open, so as to receive the other. The accompanying drawing is a representation of the simple and perfect lithotripter, now in

Fig. 212.



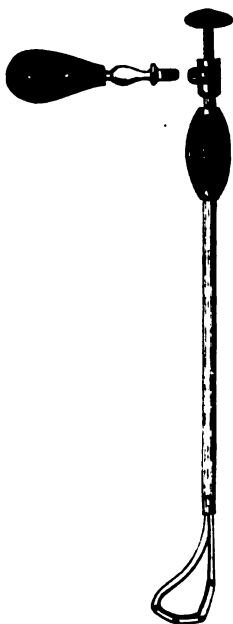
use. Mr. Weiss states that he showed his lithotripter to many professional men, and among others, to Baron Heurteloup in 1830, who, up to that time, had used the straight drill of Civiale; he immediately adopted the invention, and merely substituting the hammer for the screw, claimed it as his own, calling it his "*Percuteur Courbe à Marteau.*"

["Another instrument, the merits of which are certainly equal, if not superior, to those of the one just described, is that of Dr. Jacobson, an eminent surgeon of Copenhagen. For simplicity and facility of use, it would be difficult to conceive of anything more perfect or convenient. It consists of a silver canula, about ten inches long by three lines in diameter, the upper extremity of which is furnished with a circular steel rim, an inch in width, while the lower is slightly curved for about two inches, and terminates in a blunt point. Within this tube is a steel rod, calculated to move backwards and forwards at pleasure, and connected, inferiorly, with the one just described by means of an articulated chain consisting of three links. The superior extremity projects beyond the horizontal rim of the canula, and is furnished with a stout screw, which is intended to work the chain backwards and forwards, during the seizure and comminution of the stone. A graduated scale exists upon the instrument for measuring the volume of the stone.

"It has been alleged that the lithotripter of Jacobson is inferior, in several respects, to that of Heurteloup and Weiss; but, mainly, on account of its greater liability to pinch the coats of the bladder, and

its inability to grasp so large a calculus.

Fig. 218.



It is also said to be more difficult to seize the concretion so readily when it lies behind the prostate in a cul-de-sac of the bladder. These objections, however, are rather imaginary than real. In the first place, it is not an easy matter for a skilful surgeon, in any case, to include the coats of the bladder in the jaws of his instrument; the contingency, at all events, is a remote one, and can scarcely happen if care be taken to round off the margins of this part of the instrument; secondly, no calculus larger than what can be embraced by Jacobson's lithotriptor should ever be attempted to be crushed by this operation; and, lastly, if the stone lies low in the bas-fond of the bladder, and cannot be readily seized, the difficulty is easily remedied by the introduction of the finger in the rectum. These objections, therefore, fall to the ground. Fig. 213 represents Jacobson's stone-crusher, as modified by Velpeau.

"With either of the above instruments the operation may, in general, be safely and expeditiously performed. The percussor of Heurte-
teloup, is, I believe, but rarely used anywhere at the present day; it is an awkward and clumsy affair, and ought, in my judgment, to be dis-

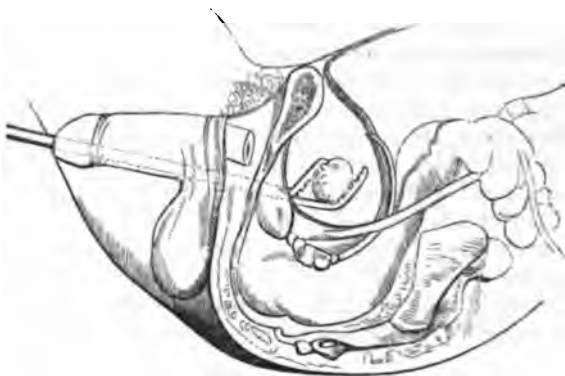
carded from our armamentarium.

"It is not every case of stone that admits of being crushed. There are certain circumstances which imperatively forbid it; and hence much judgment is frequently required to enable the surgeon to make a proper selection. When the operation was in its infancy, there is reason to believe that it was too often employed indiscriminately, both to the detriment of patient and surgeon; and, on the other hand, many persons were doubtless subjected to lithotomy who would have made excellent subjects for lithotripsy. Fortunately, a better state of things prevails at the present day; the jealousy which existed between the stone-breaker, and the knife-man, has ceased; and the consequence is, that more judgment is displayed in the selection of cases for the two operations. In this country, however, lithotripsy is still in its infancy; in fact, it can hardly be said to have received fair play from the hands of the lithotomists. Dr. Dudley, who has operated more frequently for stone than any surgeon in America, has never, I believe, employed lithotripsy; and the same is true of some of our other practitioners. Those who have busied themselves most with this operation, in this country, are Dr. Randolph, Dr. Gibson, and Dr. Pancoast, of Philadelphia, and Dr. N. R. Smith, of Baltimore; the first of whom unfortunately died too soon for the cause of surgery, which he was so nobly engaged in cultivating. Many other surgeons have occasionally resorted to it, but comparatively few have made it the subject of their special study and

practice. The operation was first performed in the United States, by Dr. Depeyre of New York." (Gross on Urinary Diseases, &c.)—ED.]

When the operation is to be performed, the patient is placed on a couch or bed of convenient height, with a pillow below the pelvis, so as to send the stone into the fundus of the bladder. If the bladder should not contain a sufficient quantity of urine to distend it, so that the stone may be crushed without injury to the lining membrane, tepid water

Fig. 214.



should be injected by means of a syringe and catheter, until the bladder contains at least six or seven ounces of fluid. The lithotriptor having been then introduced, and the stone seized, the surgeon, after previously ascertaining that no portion of the lining membrane is entangled, brings the stone to the centre of the viscus, and commences the crushing process by turning the screw; this should be done very gradually, especially at first. The crushing of the stone is felt by the operator very distinctly. If the stone be very small and friable, it may be pulverized at one seizure; but more frequently it happens that, after the first crushing, the fragments require to be seized and pulverized.

When one seizure is insufficient, the surgeon must be guided by the susceptibility of the patient in judging how frequently it may be repeated at one time, as, if a very correct judgment be not formed on this point, and if the crushing be carried to too great an extent, very serious consequences are likely to result. When the process has been continued as far as may be necessary, or as the state of the patient may render advisable at one time, a large catheter, with a peculiar opening at its extremity, is introduced, through which the urine and some of the detritus are discharged; and if considered at the time desirable, a little water may be injected once or twice, by means of a syringe, before the removal of the catheter, in order to favour the escape of detritus, it being important to bring off as much as possible through the instrument,

¹ New York Med. Jour., for February, 1831.

Fig. 214. From Liston.

as the transmission by this means occasions no irritation. Rest and antiphlogistic treatment should be strictly enjoined, and the local symptoms which supervene, must be treated according to the common principles of surgery. Fragments pass off for some days, and in their transmission through the urethra often give rise to great pain and irritation. If another operation be necessary, it may be ventured on after the effects of the first have disappeared. The cases favourable for Lithotripsy are those of adults in whom the stone is small and comparatively soft, the kidneys, bladder, prostate gland, and urethra, organically sound and free from any particular irritability, and the general constitution not more than ordinarily susceptible. There can be no doubt that in such circumstances lithotripsy, in the hands of a judicious surgeon, is a very safe and satisfactory operation; and that when these favourable conditions combine, it is to be preferred to lithotomy; but in other circumstances, supposing an operation to be desirable, lithotomy is undoubtedly that which ought to be adopted. If in all cases a correct and unprejudiced judgment be exercised, first as to whether any kind of operation be advisable, and if so, then whether in the particular conditions of each case lithotripsy or lithotomy be the more suitable operations for the removal of calculi in the bladder, will be found sufficiently satisfactory in their results. It is only the abuse of these operations that can bring either the one or the other into discredit.

CHAPTER XVI.

AFFECTIONS OF THE TESTICLE.

ORCHITIS.

INFLAMMATION of the testis may be either acute or chronic: it may commence in the body of the testicle, or in the epididymis, forming the epididymitis of some authors; and it may be either primary, as when idiopathic, or when excited by external violence, such as a bruise, a wound, or exposure to cold and wet; or, as is far more frequently the case, consecutive, the inflammation being transmitted from the urethra by spreading along the vas deferens, or perhaps by metastasis,—in which circumstances the epididymis is first attacked and most affected, the tunica vaginalis generally becoming soon involved. An example of orchitis as thus induced has been referred to in the enumeration of the consequences of gonorrhœa, a form of the disease usually acute, and known by the names of “secondary gonorrhœal orchitis,” or “hernia humoralis.” Secondary orchitis may, however, be the result of inflammation unconnected with gonorrhœa; it may arise from inflammation caused by violence in the introduction of catheters or bougies, or it may be the consequence of strictures, or of the means used to cure them. Sometimes it is an accompaniment or a consequence of mumps, in which case its production depends on metastasis.

ACUTE ORCHITIS.

Symptoms.—When orchitis is primary and acute, the symptoms are, excruciating pain in the testicle, great tenderness, especially as the disease advances,—so that in some cases the patient cannot allow the part to be touched, a distressing sense of weight, a swelling of the testicle, which, however, preserves its oval form, pain extending along the back and in the loins, where it is often extremely severe, and a red, hot, shining appearance of the scrotum. The pain and sense of weight are increased by the erect posture. In very acute cases, nausea, vomiting, and pain in the under part of the abdomen are urgent symptoms, which, in consequence of their similarity, have sometimes been mistaken for symptoms of enteritis. The most severe form of orchitis is usually that which arises from wounds of the testicle. Such injuries are therefore very dangerous, especially in individuals of an irritable habit of body. The constitutional symptoms in the acute primary form of the disease are very severe.

Consecutive Orchitis, when originating in the transmission of inflam-

matory action by continuity of tissue, is usually preceded by slight pain, weariness, and fulness in the groin, where the cord is found to be tender on pressure, and the *vas deferens* to be enlarged. These symptoms are followed by pain, tumefaction and tenderness of the epididymis, which forms an elongated swelling at the back of the testicle; in many instances this swelling is so great as to render the epididymis as large as the testis, which remains still unaffected. The inflammation soon extends to the *tunica vaginalis*, when the tumour forms a mass, the different parts of which are no longer distinguishable, and the testis itself becomes involved. The distinguishing peculiarities of this form are the symptoms along the course of the cord in the first instance, followed by the affection of the epididymis, which invariably precedes that of the testis;—the cord, epididymis, *tunica vaginalis*, and testis becoming successively affected. In this variety the swelling is usually greater, and forms more rapidly; and although there is much variety in the intensity of the symptoms, the pain and constitutional disturbance are for the most part less severe.

In the sympathetic form of gonorrhœal orchitis, namely, that in which the disease presents itself without any previous affection of the *vas deferens*—a variety sometimes met with, although rare in comparison with the last-mentioned form of the disease—there is an absence of all symptoms indicating any affection of the cord, and the inflammation commences in the epididymis.

In by far the greater number of cases of gonorrhœal orchitis the inflammation proceeds along the *vas deferens* to the epididymis. In seventy-three cases out of one hundred and four noticed by M. Aubry, the inflammation first attacked the *vas deferens*; in the remaining thirty-one the disease was sympathetic.

Gonorrhœal orchitis may occur at any period of an attack of gonorrhœa; but it most frequently commences when the pain and discharge begin to subside. On the connexion supposed to exist between the inflammation of the testis and the state of the discharge, the under-mentioned authorities give the following result of their observations. M. Gaussail states, that in sixty-seven cases out of seventy-three, the gonorrhœa diminished on the first appearance of orchitis; M. Aubry, that in fifty-eight cases out of eighty-one, there was diminution of discharge at the commencement of inflammation of the testicle; and M. D'Espine mentions that in only six cases out of twenty-nine the discharge continued unchanged; while in the remaining twenty-three, it was variously modified, being increased in some, diminished in others, and in others entirely suppressed.

Late observations have shown the incorrectness of the opinion which at one time prevailed, that secondary orchitis is more frequent on the left side than on the right. Of seventy-three cases mentioned by M. Gaussail, forty-five were on the right side, twenty-four on the left, and four were double; of twenty-nine observed by M. D'Espine, twelve were on the right side, eleven on the left, and six double; and of thirty-six which occurred in the practice of Mr. Curling, twenty-one were on the right side, fourteen on the left, and only one double: so that of one

hundred and thirty-eight cases it appears that seventy-eight were of the right testicle, forty-nine of the left, and eleven of both.

Treatment.—The local treatment of acute orchitis consists in the use of leeches, rest, recumbency, support of the testicle, so as entirely to obviate the effects of gravitation, and warm fomentations. Opening a vein in the scrotum is often a convenient mode of local depletion. When the tunica vaginalis is involved and much pain is experienced from tension, great relief is often experienced from evacuating the accumulated serum. Cold evaporating lotions sometimes give more relief than warm fomentations or poultices; the feelings of the patient are the surest guide, whether the warm or the cold are preferable.

The constitutional treatment consists in the use of low diet, rest, the free exhibition of antimony, general depletion when the inflammatory symptoms and sympathetic fever are urgent, and after the pulse has been lowered by antimony, and other means, resolution is often promoted, and structure saved, by the use of mercury. Both in the idiopathic form, when the testicle is principally involved, and in the consecutive, when the inflammation has its seat principally in the epididymis and tunica vaginalis, mercury is exceedingly useful: some surgeons confine its use almost entirely to primary, and others to secondary orchitis. I have used it pretty generally in both classes of cases, and am perfectly convinced that much advantage results from doing so. As inflammation originating in the testicle is not only more painful and attended with more constitutional disturbance, but also more apt to endanger the structure and function of the part affected, this form of orchitis requires even more prompt and decided treatment than the others. If suppuration should occur, which is more apt to take place in primary than consecutive orchitis under proper treatment, free incision should be made as soon as there is decided evidence that matter has formed; by this proceeding the tubular portion of the organ will be less endangered, and sinuses and fistulous passages probably prevented.

When the disease has become chronic, the greatest benefit is often experienced from the cautious employment of pressure, applied by means of adhesive plaster cut into strips, the testicle being separated from its fellow, and the scrotum drawn off as much as possible from the diseased testicle, to admit of the proper application of the strips of plaster. Of the advantages of this treatment in chronic cases, I can speak in the strongest terms. Dr. Fricke of Hamburgh suggested treatment by compression, both in acute and chronic cases, and states as the result of that proceeding, that of fifty-one cases of acute orchitis, eighteen having been treated in the ordinary method, and thirty-three by compression, the average duration of the disease in the former was thirteen days, in the latter only nine days. Ricord, Cullerier, Parker, Acton, Curling, Hamilton, and others, have spoken favourably of the results of this practice; but in acute cases I have had no opportunity of forming a judgment upon it from my own personal observation.

CHRONIC ORCHITIS; OR, FUNGUS OF THE TESTICLE.

This affection occasionally succeeds acute orchitis, as a result of the inflammation being imperfectly resolved; but it is much more frequently

chronic from its commencement. By far the most frequent cause of chronic orchitis is urethral disease, such as gonorrhœa, or stricture, the inflammation being conveyed along the vas deferens to the epididymis. Irritation of the urethra, induced by other affections of the urinary organs, is sometimes the exciting cause. It ought, however, to be remembered, that this disease is not invariably owing to the state of the urethra. Excessive indulgence of the passions, a reduced state of the vital powers, debility resulting from a long-continued course of mercury, are all regarded as predisposing causes. It has been sometimes known to come on during attacks of gout and rheumatism; and hence these diseases have been said to be favourable to its occurrence.

Anatomical characters.—The principal anatomical character of this disease is a yellow homogeneous deposit which does not become vascular, and which is at first soft, but ultimately becomes more solid and firmly adherent to the parts with which it is in contact. This deposit is the ordinary result of the various forms of the disease, and on it the enlargement depends. Pathologists have been anxious to determine in what textures the matter is originally deposited.

Cruveilhier, who has given an interesting description of this disease, illustrated by coloured plates, supposes* that the yellow substance is originally deposited in the cellular tissue of the testis, and that it radiates along the fibrous partitions from the corpus Highmori. But although in very advanced cases it may be found in the cellular tissue, yet, from the dissections of Sir Astley Cooper, Sir Benjamin Brodie, Mr. Curling, and many others, it appears certain that it is originally deposited within the tubuli testis, and that it is a secretion in them by the lining membrane. It has been found in them, in the rete testis, the epididymis, and the vas deferens.

The disease may give rise to serous effusion into the tunica vaginalis, producing fluctuation; or to effusion of lymph, causing obliteration of the sac, or to ulceration of the coats of the testicle, and of the parietes of the scrotum, and to eventual protrusion, through the opening, of a yellowish, firm, comparatively painless fungus, which, being part of the testicle itself, the condition has very properly received the name of *Hernia testis*. In many cases the surface of the protruded part becomes covered over with a layer of weak granulations, affording a copious discharge; but in many which I have seen no granulations were formed. The tumour consists of the tubuli testis with the yellow deposit, the part being pressed out by the morbid deposit when resistance can no longer be offered by the coats of the testicle, and the parietes of the scrotum, they having given way by ulceration. In some instances, the whole of the organ has protruded. The protrusion may or may not be preceded by slight suppuration, as well as by the yellow deposit, and sometimes pus is deposited in various parts, giving rise to abscesses and sinuses; and creating a necessity for castration.

Such are the anatomical characters of chronic orchitis, when it runs its course.

Symptoms.—The principal symptoms of this disease are slight pain, or a sense of uneasiness, or weight in the part. The uneasiness, however, is not great, and in some instances is so slight that the disease has

been known to make considerable progress before the patient has been aware of its existence. The testicle feels hard and incompressible. The hardness and pain are both greater before the coats of the testicle have given way, than afterwards. There is slight tenderness or pain on pressure, at the commencement of the inflammatory process; but after the disease has existed for some time, the tenderness on pressure is very inconsiderable, and (what is very remarkable), when, at an advanced stage of the disease, protrusion of the substance of the testicle has taken place, it is found to be nearly, if not entirely, insensible. If suppuration precede protrusion, the patient will exhibit the ordinary local signs of inflammation. The suppuration is always limited, as is also the softening which it induces. The general swelling usually diminishes to a certain extent, when the scrotum has given way.

Treatment.—The result of treatment is usually satisfactory, if commenced at an early period. It may be said to consist in the removal of the cause of the disease, rest, a course of mercury carried to an extent sufficient to produce an impression on the system, and the careful employment of pressure by the mode already described. Mercury is the grand remedy, and in few diseases is more benefit derived from its use. Blue pill, alone or in combination with opium, as symptoms may indicate, is one of the best modes of administering it. In many cases I have used the proto-iodide of mercury in doses of a grain and a half night and morning, and with the most beneficial results. During an accession of inflammatory symptoms, local depletion by leeches may be necessary, but depletion forms no prominent part of the treatment of this disease. When protrusion has taken place, the mode of treatment now adopted is that for which we are indebted to Professor Syme. It consists in slightly enlarging the opening through which the protrusion has taken place, removing the hard ring of integument which constitutes the margin of the opening, bringing the integument completely over the protruded part, and retaining the opposite sides of the opening in apposition by means of sutures. This treatment has now been fairly tried in many cases, and, as far as I know, has been uniformly attended with the desired result. It is certainly a great improvement on the practice which formerly prevailed, namely, that of shaving off the fungus, or destroying it by escharotics, and endeavouring afterwards to heal the wound;—a treatment, in some instances, so tedious and unsatisfactory, that castration has often been deemed more expedient.

NERVOUS AFFECTIONS OF THE TESTIS.

There are two varieties of nervous affections of the testicle, namely, "Irritable Testis," and "Neuralgia of the Testis."

IRRITABLE TESTIS.

This affection, which is an increase of the natural sensibility of the organ, is usually met with in weak, irritable, dyspeptic, and hypochondriacal persons, and is for the most part dependent on some affection of the urethra, or of the genital system, or on disorder of the general health. It sometimes occurs after great indulgence in sexual inter-

course, or after much venereal excitement; and it has been known to be a consequence of onanism, and of involuntary seminal emissions. The sensibility of the organ is increased to a most painful extent, so that in some cases the part is intolerant of manipulation, and even the contact of the dress is painful. In some instances both sides are affected, a circumstance in which morbid sensibility differs from Neuralgia of the Testis. The uneasiness is usually increased by exercise, and by the erect posture, and is sometimes so great as to oblige the patient to abstain from exercise, and to remain at rest in the recumbent posture. As this distressing complaint yields to treatment, castration is not necessary; nor would it be always effectual, as the disease has been found to return in the cord. In some cases in which patients have insisted on castration, opportunity has been afforded of examining the condition of the testis, which, in no instance, as far as I know, was found to differ from the normal state, except that slight dilatation of vessels was in a few instances observed.

In the treatment of this affection, the principal indications are, to remove the cause, to improve the general health by such means as are most judicious in the particular circumstances of the case, and to diminish the preternatural sensibility of the parts by local bathing, and the application of anodyne lotions. Lotions containing opium, belladonna, or tincture of aconite, or combinations of these medicines, are often exceedingly useful. In several instances this affection has been cured by complete change of scene, air, and mental occupation, without any other treatment except support of the testis.

NEURALGIA OF THE TESTIS.

In this distressing affection there is constant uneasiness, sudden, severe, and remittent attacks of pain, occurring in paroxysms of variable duration, and generally at irregular but sometimes at regular intervals, like other neuralgic pains. The pain is most excruciating, and during its continuance the testicle is drawn up by spasmodic contraction of the cremaster muscle, and in some instances the pain is attended with nausea and vomiting. This affection possesses the characters of tic douloureux, or true neuralgia, and is almost always confined to the spermatic nerves of one side. It is most frequently met with in weak, irritable, and dyspeptic persons, and attended with a disordered condition of the digestive organs; and the intense pain and want of rest in most cases give rise to derangement of the general health. Occasionally this affection has been found to succeed an attack of orchitis, and to recur whenever the patient's health has become disordered, and in several cases it has been known to be excited by the morbid condition of the veins in varicocele: but in the great majority of instances the cause of the disease is exceedingly obscure; and when, on account of the severity of the pain, patients have insisted on castration, dissection has not discovered anything to account for the pain; for the structure of the testis has almost always been found to present a perfectly healthy appearance, except in some examples, in which there was a slight fulness of vessels, the effect probably, and not the cause, of long-continued pain. Castration is not advisable, for although in some instances the result

has been favourable, in others the disease has returned in the cord ; and moreover, the disease usually yields in time to the treatment proper for neuralgia in other parts, which has been already described.

TUBERCULAR DISEASE OF THE TESTICLE, OR SCROFULOUS TESTICLE.

This disease sometimes occurs in children, a fact, of which a considerable number of examples are recorded, and of which I have seen two, in boys of five and seven years of age ; but it has been found advanced to the stage of suppuration at a still earlier period. The most common time for its appearance is at puberty, or between that period and the age of twenty. It is generally found only in one testicle, but sometimes both are affected.

Symptoms.—The patient feels uneasiness in some part, generally in the epididymis, where, on examination, enlargement and induration may be perceived. The hardness is greater than in common chronic orchitis, but less than in scirrhus affections of the testicle. In most cases uneasiness is afterwards experienced in another part, commonly also in the epididymis, and on examination another swelling with the same characters is discovered. The disease is always slow in its progress, and often appears as if stationary ; but after a considerable period the enlargement becomes greater, the uneasiness increases, the integument becomes of a dark livid red colour, and adherent to the large part, and at last an abscess forms, from which pus mixed with tubercular matter is discharged. The quantity of matter discharged is not great, the abscess does not readily heal, a fistulous opening forms, through which a thin discharge, sometimes mixed with seminal fluid, continues to ooze. Sometimes hernial protrusion takes place of the tubercular matter. The slight fungus thus formed is easily distinguished from protrusion of the substance of the gland in chronic orchitis by being much softer, of less extent, and more easily broken down. From what will be stated under the head of treatment it will be evident that the diagnosis in these cases is very important. It is not often that the whole testicle is destroyed by the disease ; in the great majority of cases a considerable portion of the organ remains in a sound state. In an advanced stage of the disease the original humour may not be so easily perceived, on account of general swelling caused by effusion into the tunica vaginalis. The patient in most instances exhibits scrofulous affections in other parts.

Anatomical Characters.—The swelling presenting the characters already described depends on tubercular deposit, the seat of which is more frequently in the epididymis than in the testis. Cases have occurred in which the entire epididymis has been found to be occupied with this deposit, while the structure of the testis was perfectly sound. The deposit is met with in various situations, often at the ends of the epididymis, the globus major being more frequently affected than the minor. It is a question whether tubercular matter is originally formed in the tubuli themselves, or in the cellular tissue connecting them together. The dissections of various competent observers lead to the conclusion, that it may take place both within and without the tubuli. It has been found in the interior ducts forming the epididymis, and in the vas deferens, and sometimes in the processes sent in from the tunica albuginea to

support the lobules composing the testis. In the section on Tubercular Tumour will be found an account of the views at present entertained of the origin of Tubercular Deposit, together with a description and delineation of its appearance viewed under the microscope.

Treatment.—The treatment is both constitutional and local. In this as in other scrofulous affections, constitutional treatment is of the first importance. The constitutional treatment proper in cases of Scrofulous Deposit will be detailed in the section on Tubercular Tumour. With regard to the local treatment, support of the testicle is indispensable in every stage of the disease. In its first stage, and when the morbid action has become chronic, rubbing the part with iodide of potassium ointment, or with an ointment of the iodide of potassium and iodine, or painting it every second day with tincture of iodine, or strapping the testicle with the emplastrum ammoniacum, are suitable local remedies. My own experience leads me to prefer painting the part with tincture of iodine in preference to any other application. When local inflammatory symptoms present themselves, the most useful remedies are, rest, elevation of the testicle, leeches, and cold lotions; and should suppuration occur, early evacuation of the matter by direct incision is important. After evacuation of the matter, it is sometimes advisable to destroy the diseased parts by means of the nitrate of silver, after which a healing action is more readily induced. Should protrusion of the tubular portion occur, the treatment of preserving the part and bringing the integument over it is not suitable, though so successful in the case of fungus in chronic orchitis; but the protruded part should be destroyed by some powerful escharotic, such as the potassa fusa, or the chloride of zinc. Sometimes the destruction of the substance of the testis is so extensive from tubercular deposit, suppuration, and sinuses, as to render ineffectual every proceeding except castration.

FIBROUS TRANSFORMATION OF THE TESTIS.

The principal symptom of this comparatively rare affection is, great induration. In some cases the testis has been found unchanged in size; in some, slightly diminished; in others enlarged. It is distinguished by the absence of pain or any particular inconvenience, by not being of a malignant character, and by occasioning little discomfort, except when the patient becomes alarmed, and the affection is in consequence a source of mental anxiety. I have met with only one example of this disease in my own experience; and in that I was obliged to resort to castration, on account of the patient's excessive anxiety, in consequence of which his general health had been seriously injured. The only local symptoms in this case were, great induration, slight enlargement, and a sense of weight in the affected part. When, from the above-mentioned cause, castration is deemed advisable, it may be resorted to with every prospect of satisfactory success, as the disease is not of a malignant character. No treatment is of any avail. The disease seems to consist in the change of the cellular tissue into fibrous, and the new development of fibrous tissue, the presence of which causes obliteration and removal of the secreting structure. Dissection has revealed two varieties of the disease; one, the more common, in which the testis becomes firm and dense like the fibrous tumour of the womb; and the other, in which the structure is compara-

tively loose, and slightly infiltrated with a serous fluid. The anatomical and microscopic characters of fibrous tumour are more particularly described in the chapter on Tumours.

CYSTIC SARCOMA.

Symptoms.—This rare affection, called by some hydatid disease of the testicle—an improper appellation, inasmuch as the cysts are not of the nature of animal hydatids,—is chiefly met with in the middle period of life, rarely before the eighteenth or after the fortieth year. It begins in the testis, and is unattended with pain, tenderness on moderate pressure, redness, heat, transparency, enlargement of the cord or glands in the groin, or with any constitutional disturbance, or derangement of the general system. These negative symptoms are very important to be noticed for the purposes of diagnosis. There is a swelling, the peculiarities of which are, that it increases very slowly, is usually of an oval form, has a smooth surface, and though somewhat uneven in its general outline, has none of the irregular knotted surface peculiar to scirrhus. The swelling is not so pyriform as in hydrocele, but like the testicle itself, is compressed laterally. It feels heavy, and not only creates inconvenience by its size, but when it becomes large, causes an uneasy sensation and dragging pain in the lumbar regions from its weight, especially when unsupported. With regard to its fluctuation, it has been well remarked, "When the swelling is handled, it communicates an impression that it contains a fluid, for it easily yields on pressure; yet there is no true fluctuation, for the tumour does not rise at a distance, as it sinks under the pressure of the finger, but it yields only at the spot compressed." It is, in fact, more a yielding than a fluctuation. The veins of the cord are enlarged.

By these marks the disease may be distinguished from hydrocele and encephaloid cancer, the only two affections with which there is any risk of confounding it.

Anatomical Characters.—The testicle consists of cysts varying much in number, size, thickness of their parietes, and nature of their contents. At an early stage of the disease there may be only a few, but at an advanced period they are almost innumerable; they are small and vascular at first, and contain a transparent fluid. As the cysts increase, the secreting structure of the testicle becomes atrophied and removed, and often wholly destroyed; the cysts increase in number, thickness, and size; and their contents, instead of remaining transparent, become viscid, thick, albuminous, and often present the appearance of a mucous secretion. The contents of the cysts present at least as great varieties as the size and thickness of the parietes in which they are contained; the latter becoming sometimes exceedingly dense and firm. The tunica albuginea and tunica vaginalis become thickened, and the surfaces of the latter more or less adherent.

Treatment.—Castration is the only proceeding attended with any advantage, and as the disease is not of a malignant nature, the results of that operation are almost invariably satisfactory. In some exceedingly rare instances, medullary disease has been found combined with the affection; in such cases an operation is quite unsuitable, inasmuch as it cannot save life.

ENCEPHALOID CANCER OF THE TESTIS.

This malignant disease, described under the names of soft cancer, fungoid disease, fungus hæmatodes, medullary sarcoma, pulpy testis, and encephaloid cancer, is by no means uncommon; and, although no age can be said to be exempt from it, many instances of it being recorded even in children and young persons, yet it much more frequently occurs between the ages of eighteen and thirty-five, than at any other period of life.

Symptoms.—For the purpose of diagnosis, the peculiarities of the different symptoms require to be minutely observed. Swelling is the earliest symptom: it begins in, and is for some time confined to the testicle, and while so confined, is globular, being somewhat of the shape of an orange, instead of being compressed laterally, as the testicle in the normal state is. It is rather hard at first, pretty uniform in its general outline, and entirely destitute of fluctuation. As the disease advances, the epididymis becomes involved, and there may occur slight effusion into the tunica vaginalis, constituting the condition called by some hydro-sarcocoele; and when the disease has advanced thus far, the swelling may be less flattened laterally, and present more of the pyriform shape of hydrocele. As the disease advances still further, the cord and the glands in the groin become affected, and at last firmly adhere to the surrounding parts. The swelling of the testicle, as has been already stated, is at first round and regular; afterwards it becomes uneven, and on examination has an elastic feel, which is very deceptive, and, unless examined carefully, may be mistaken for fluctuation. If the surgeon be induced by the elastic feel to make a puncture, blood only escapes. In the early stage of the disease, the integument is free from discoloration, and does not adhere to the swelling; in the next stage it still does not adhere, and has a natural appearance, but the veins in it are varicose; and in the third stage the integument is involved, adheres to the tumour, and presents a dark livid discoloration; and if the patient do not very soon fall a victim to the disease, the integument at last ulcerates, and a fungus, which frequently bleeds, starts up and increases rapidly. It is, however, very rare to see this fungus, as the disease generally proves fatal by the constitutional symptoms, before it arrives at that stage. I once had an opportunity of seeing the disease in that stage in a member of the Profession, who was a pupil of my own; and in that case the hemorrhage from the fungus was at times very considerable. The pain at first is not constant, but ultimately becomes very severe, and in the cases which have come under my own observation, the patients have described the pain as a most distressing feeling of weight, as if a heavy body rested on the testicle. In some instances the tumour in the loins is exceedingly painful; but in others it gives rise to comparatively little uneasiness—a circumstance which Sir Benjamin Brodie supposes to depend on the fact of the tumour sometimes pressing on the nerves, and sometimes being in a measure removed from them. The pain in the testicle and in the loins is in some cases most distressing. The extremity on the affected side becomes swelled and oedematous: in some instances the glands in the opposite groin become affected; and the scrotum, glands of the groin, integument, and pubes, all become firmly

adherent to each other, and in a measure all involved in one diseased mass. It is very rare for both testicles to become affected, and, singular as it is, one testicle is often found to all appearance perfectly sound, while the scrotum around it is completely involved in the disease of the opposite side. The disease increases very rapidly, the appetite fails, the countenance is sallow, the body becomes very rapidly emaciated, and the patient falls a victim to the symptoms of cancerous cachexia.

Such are the principal symptoms of this most distressing and incurable disease. Of the present state of our knowledge of the origin, and anatomical and microscopical characters of encephaloid cancer, an account will be given in the section on Carcinoma in the chapter on Tumours. The disease is invariably fatal, whether the part be removed or not. No treatment has any effect in arresting its progress, and all that the surgeon can accomplish by medicine, and indeed the only course that it is proper to pursue, is to alleviate the suffering caused by some of the most urgent symptoms.

SCIRRHUS OF THE TESTICLE.

This is a very rare disease, and as yet no case of it has come under my observation, either in public or private practice. Sir Astley Cooper says he has seen but a few examples, and gives the following description of the disease:—"A truly scirrhus affection of the testicle begins in the body of it, with an extremely hard swelling, which may immediately inform the surgeon of the nature of the disease. It feels like a marble body lodged within the scrotum, and it is tuberculated on its surface. It sometimes begins in the centre of the testicle, and gradually extends until the whole is involved in the disease. The epididymis next becomes the seat of the disease, that portion being first attacked which communicates with the vas deferens. The spermatic cord becomes enlarged, and tubercles of various sizes form upon it. After the spermatic cord has become enlarged, a hard tumour forms beneath the emulgent artery, which may be felt through the abdominal parietes. In true scirrhus the testicle does not become enlarged to any considerable size. After the swelling in the loins, the thigh becomes enlarged and oedematous on the side of the disease, which arises from the obstruction to absorption; and the pressure on the veins may also have influence in producing this effect." Prognosis is as unfavourable here as in examples of scirrhus in other situations. The common and microscopic characters of fibrous carcinoma are described and delineated in the chapter on Tumours.

EXCISION OF THE TESTICLE.

The hair having been shaved from the pubes, the patient having been brought under the influence of chloroform, and placed in the recumbent position, with the thighs separated, the surgeon with his left hand grasps the tumour behind, so as to make the integument tense in front, and then makes two elliptical incisions, extending from the external aperture of the inguinal canal to the under part of the swelling, and embracing between them as much integument as it may be necessary to remove with the view of preventing redundancy after the operation. Due allowance, however, must be made for the integument drawn from surrounding parts, resiling after removal of the tumour. The cord should

then be exposed, firmly grasped by an assistant, and cut through as low down as may be compatible with the entire removal of the disease. The operator takes hold of the under portion of the cord, and with a few movements of the knife extirpates the testicle. The vessels of the cord having been tied, as well as any other vessels that may be found to bleed, the edges of the wound are approximated, dressed according to approved principles, and supported by a T bandage. The under part of the wound hardly ever heals except by granulation, and on that account it can answer no useful purpose to approximate the edges closely below.

HYDROCELE.

We shall refer to five forms of hydrocele; namely, three of the tunica vaginalis, and two of the cord. The former is named, simple hydrocele of the tunica vaginalis testis, congenital hydrocele of the tunica vaginalis, and encysted hydrocele of the testis; and the latter, diffuse and encysted hydrocele of the cord.

I. SIMPLE HYDROCELE OF THE TUNICA VAGINALIS TESTIS.

Symptoms.—There is swelling, which is generally round at first, but as it increases it assumes a pyramidal form, with its larger extremity downwards, the upper extending as the disease advances, as high as the inguinal canal. When the swelling is very large, the upper extremity expands considerably, and loses the narrowness of its form. If the hydrocele be large, the scrotum, owing to its great distension, loses its natural wrinkles, and assumes a glazed appearance; and in consequence of the integuments being drawn upon the tumour, the penis seems contracted, and the raphé of the scrotum is, as it were, pressed to the opposite side: the swelling feels much lighter than a tumour of the same size caused by disease of the testicle. Besides its form and lightness, the swelling has another character which it is of importance to observe, as it assists in making out the diagnosis between hydrocele and hernia—it commences at the under part of the scrotum, and increases from below upwards; whereas a scrotal hernia commences from above and extends downwards. The history of the symptoms thus become useful for assisting the diagnosis.

Fluctuation is usually another symptom of hydrocele, but it is sometimes not easily perceptible, when the scrotum is very greatly distended; and its absence is not a proof that a tumour is not hydrocele.

Another symptom is transparency, the presence of which is a sure proof of hydrocele. On this subject, Mr. Pott remarks:—"The absence of transparency is not a proof that a tumour is not a hydrocele;" and Professor Samuel Cooper observes that—"although the absence of transparency is not a proof that a tumour is not a hydrocele, yet its presence is an infallible test that it is." According to Sir Astley Cooper, we never fail, on proper examination, to discover transparency in such hydroceles as are formed in this country; but in persons who have had hydrocele formed in warm climates, the parietes of the scrotum are sometimes rendered so thick as to be no longer transparent. Two cases have come under my own observation, in which it was impossible to discover any transparency; the one in private prac-

tice, the other in a patient under my care in the Royal Infirmary, Aberdeen. In each case the fluid was of a greenish black colour, and very grumous; and to this condition, in both instances, I referred the absence of transparency. In the situation of the testicle the tumour is always opaque. In common hydrocele another symptom useful for diagnosis is, the free state of the cord; in hernia the cord is covered by the swelling, but in hydrocele it can be felt free in the inguinal canal. Another symptom of a tumour being a hydrocele is, its freedom from pain or tenderness under ordinary circumstances, or even on pressure, except at the testicle, where there is slight tenderness on pressure; but at other parts there is no tenderness, and beyond inconvenience from its bulk and a sense of weight, the swelling gives rise to little or no discomfort.

State of the Parts.—The swelling is caused by a fluid which is usually transparent, and of an amber, pale yellow, or straw colour, sometimes, though rarely, of a greenish or blackish green colour. Sometimes it is thick, and of a grumous appearance, and occasionally it contains a quantity of flaky matter, composed chiefly of albumen; and in some instances, more especially in old persons, the fluid contains cholesterine in the form of minute shining particles. The seat of the fluid is the tunica vaginalis, which in most instances is transparent and simply distended; but sometimes it is thickened, and occasionally, in consequence of previous adhesions, it presents a sacculated arrangement, constituting what is called a multilocular hydrocele. The usual situation of the testicle is at the back of the swelling and below its middle, and this is the situation in which, from its natural relations, it might be expected; as it is not in the normal condition of the parts adherent to the surrounding parietes laterally or anteriorly, but only posteriorly: but in some cases, in consequence of adhesions having been contracted between the tunica vaginalis propria and the tunica vaginalis reflexa by inflammation previous to the occurrence of hydrocele, it is found in the front or in other parts of the swelling. It is, of course, of much practical importance to ascertain the situation of the testicle, that it may be avoided in the operation; the opacity, and the tenderness and doughy feel on pressure will indicate its position.

Treatment.—The treatment adopted in all cases, except those of children, is by operation, and that of two kinds, palliative and radical; the former consisting in merely drawing off the fluid by tapping, the latter in doing this, and also in using means for the purpose of inducing such changes as may prevent the return of the fluid.

The radical treatment by injection is that practised at the present day. The instruments necessary for this proceeding are a round trocar, and a caoutchouc bag with a nozzle and stop-cock, or a syringe; the fluid, port wine or a solution of the sulphate of zinc, or a fluid containing one part of the tincture of iodine and three of

Fig. 215.



water, or a very small quantity of the tincture of iodine alone. The patient should be placed erect; the surgeon should with his left hand grasp the tumour behind, so as to render it prominent and tense in front, and with his right hand send the trocar and canula through the parietes, holding them perpendicular to the surface until penetration be effected, and then directing them obliquely upwards, so as to diminish the danger of wounding the testicle. The trocar having been withdrawn, and the fluid allowed to escape, the injection is thrown into the canula by adapting to it the nozzle of the caoutchouc bag, or the syringe. The injection is allowed to remain, until the patient feels pain in the loins or testicle, when it is withdrawn.

Fig. 216.



The time for its remaining varies in different persons; in adults it is usually from four to seven minutes; but in all cases it is withdrawn when the patient begins to feel pain in the testicle or along the course of the cord. In addition to the pain, patients often experience a feeling of faintness and sickness. The fluid having been withdrawn, the patient should be put to bed, the testicle supported, and the after-treatment regulated according to the character of the supervening symptoms. If no symptoms of inflammatory action present themselves, the patient should be induced to move about, and be allowed a generous diet, and the scrotum should be

gently compressed and handled so as to occasion friction between the surfaces of the tunica vaginalis; but if the inflammation threaten to be excessive, or so great as to render suppuration probable, rest, low diet, support of the testis, and the ordinary treatment for acute orchitis, should be enjoined. The tumour usually returns very quickly, and often requires the size of the hydrocele previous to the tapping; but in the course of twelve or fourteen days, under proper treatment, the parts generally resume their usual size. At one time it was supposed that injection effected a radical cure by the obliteration of the cavity of the tunica vaginalis caused by complete adhesions of the surfaces of that membrane; but it is now known that, although the serous surfaces are sometimes united, this state is not essential, that more commonly the adhesions are only partial, and that the cure is produced by an alteration in the secerment function of the membrane. Many different kinds of fluid have been used for injection, as dilute spirits of wine, dilute port wine, port wine undiluted, solution of alum, solution of the sulphate of zinc, cold water, lime water, and tincture of iodine, either alone

Fig. 216. From Liston.

in very small quantity, or mixed with water in the proportion of one part to three. Until lately, port wine and the solution of sulphate of zinc were the favourite injections, but the tincture of iodine with water is now generally preferred. Mr. Martin, a surgeon in India, was the first who tried iodine injections. His proceeding was, to use one part of the tincture to three of water, to inject only a very small quantity, and to allow it to remain; and the result of this practice was, that of two thousand three hundred and ninety-three cases treated at the native hospital of Calcutta, the failures were under one per cent. The use of iodine injections has since been tried by surgeons in most parts of the world, and, so far as their experience is recorded, with satisfactory results. Some use a very small quantity of the tincture alone, and allow it to remain. Others, and perhaps a larger number, use the injection of the strength employed by Mr. Martin, and allow it to escape. My own experience in the use of iodine and water, allowing it to escape, has been most satisfactory.

In children it is not advisable to have recourse to injections; neither is it necessary, as the swelling is in most cases easily dispelled by the application of discutient lotions; and when this treatment is not found to produce the desired result, simple puncture with the lancet, and escape of the fluid, are usually followed by a radical cure.

In two other conditions injection is not advisable, namely, when the testicle is diseased, and when, though it is sound, the hydrocele is very large. In the latter case the most prudent method of proceeding is to evacuate the fluid by tapping, to allow its reaccumulation until the hydrocele attain a moderate size, and then to proceed with tapping and injection.

Various other methods of treatment have been employed for effecting a radical cure, as incision, excision, caustic, seton, and acupuncture; but as these methods have almost all fallen into complete desuetude, it is unnecessary to describe them.

II. CONGENITAL HYDROCELE OF THE TUNICA VAGINALIS.

This differs from common hydrocele, inasmuch as the fluid communicates with the cavity of the peritoneum by a vaginal process of that membrane, within the inguinal canal. In this variety, injection must never be employed while the communication remains, as peritonitis might result from the extension of the inflammation to the abdomen. The first indication is, to obliterate the tubular communication with the abdomen; and the best means for this purpose is gentle pressure by the use of a truss. After the obliteration has been accomplished, the tumour is often dispelled in children by the use of discutient lotions, and in adults the usual treatment of injection may be employed. The only judicious operation in any case before obliteration, is the simple drawing off of the fluid.

III. ENCYSTED HYDROCELE OF THE TESTIS.

In this form the fluid is contained in a cyst, or cysts, distinct from the cavity of the tunica vaginalis. These collections present the three following varieties:—*first*, they occur, and that most frequently, below

that part of the tunica vaginalis which covers the epididymis ; and the cysts differ greatly in size, number, and form, being in some instances small and pressed into the epididymis, while in some the tunica vaginalis is raised up by them, and they assume a pendulous, pedunculated form, and in others they become large, but remain connected with the epididymis by a broad base ; *secondly*, they occur between the tunica albuginea and the tunica vaginalis testis ; in this, which is the rarest form of all, the cyst is usually single and of small size ; and *thirdly*, between the layers of the loose or outer portion of the tunica vaginalis.

In encysted hydrocele the tumour should not be interfered with, unless it become troublesome from pain, or inconvenient from its size. When interference is deemed advisable, the most judicious proceeding is merely to draw off the fluid by simple puncture. If the tumour should return, and it be thought advisable to endeavour to effect a permanent cure, as the treatment by injection has not been found to succeed so well as in common hydrocele, the preferable treatment, especially when there is a number of cysts, is the use of a seton, which should be introduced and retained until consolidation be effected.

HYDROCELE OF THE CORD.

Of this affection there are, as has been already stated, two varieties, namely, diffuse and encysted.

I. DIFFUSE HYDROCELE OF THE SPERMATIC CORD.

This exceedingly rare variety consists of an albuminous fluid of a white or yellowish colour, diffused throughout the cellular tissue connecting the vessels of the spermatic cord, which tissue is surrounded by a cellular sheath, and this sheath, again, is invested by an expansion of the cremaster muscle and the coverings of the cord external to it. The affection is of the nature of simple œdema ; the cells, however, are so greatly distended as to be converted into large vesicles. In some instances, at the lower part of the tumour, the cells disappear, and the fluid at that part is contained in a single cavity, where it forms a swelling attended with fluctuation. An example of this rare form of hydrocele has not come under my own observation. Mr. Pott, who appears to have met with more examples of it than any other surgeon, gives the following description of its symptoms and appearances :—"In general, while it is of moderate size, the state of it is as follows : The scrotal bag is free from all appearance of disease ; except that when the skin is not corrugated, it seems rather fuller, and hangs rather lower on that side than on the other, and if suspended lightly in the palm of the hand, feels heavier ; the testicle, with its epididymis, is to be felt perfectly distinct below this fulness, neither enlarged nor in any manner altered from its natural state ; the spermatic process is considerably larger than it ought to be, and feels like a varix, or like an omental hernia, according to the different size of the tumour ; it has a pyramidal kind of form, broader at the bottom than at the top ; by gentle and continued pressure it seems gradually to recede or go up, but drops down again immediately on removing the pressure, and that as freely in a supine as in an erect posture ; it is attended with a very small degree of pain or uneasiness,

which uneasiness is not felt in the scrotum, where the tumefaction is, but in the loins. If the extravasation be confined to what is called the spermatic process, the opening in the tendon of the abdominal muscle is not at all dilated, and the process passing through it may be very distinctly felt; but if the cellular membrane, which invests the spermatic vessels within the abdomen, be affected, the tendinous aperture is enlarged, and the increased size of the distended membrane passing through it produces to the touch a sensation not very unlike that of an omental hernia."

Treatment.—While the swelling is small and unattended with particular inconvenience, the most judicious course is not to interfere with it. When interference becomes necessary, the best mode of treatment is acupuncture. The punctures are made at the under part of the swelling, and need not be numerous. The fluid escapes into the cellular tissue of the scrotum, and is soon removed by absorption. This mode of treatment is unattended with danger, whereas free direct incision into the cells is not so.

II. ENCYSTED HYDROCELE OF THE SPERMATIC CORD.

The symptoms of this variety are a swelling, slow in its growth and painless, usually of an oval form, movable on the cord, attended with fluctuation, and in most instances, distinctly transparent. The tumour is generally circumscribed, and the testis can be felt separate. This affection is most common in infants, but it is met with at all periods of life. The fluid is sometimes of a straw colour, but more frequently limpid, and contains little or no albumen. Occasionally more cysts than one are found; but this is unusual, the fluid being generally contained in a single cyst. This cyst is in most cases formed of an obliterated portion of the vaginal process of peritoneum drawn down at the period of the descent of the testicle; sometimes however the cyst is an adventitious formation. It is embedded in the cellular tissue connecting the vessels of the cord with each other, and is embraced by the other coverings of the cord.

In children, this affection usually disappears under the use of applications calculated to promote absorption, as in simple hydrocele at the same period of life; and in adults, if interference be necessary, the cure may be accomplished either by tapping and injection, or by the use of a seton.

CHAPTER XVII.

AFFECTIONS OF GENITO-URINARY ORGANS.

GONORRHOEA.

THE essential and characteristic symptom of gonorrhœa is a purulent, or muco-purulent discharge from the urethra of the male, or the vagina of the female.

It may be either *simple* or *virulent* in its nature. In the former case, it is caused by sympathetic irritation, such as teething; or it is but a symptom of the existence of other affections, generally of rheumatism or gout. In the latter, it depends upon the direct application of a specific irritant, occurring usually during sexual intercourse.

When it assumes a chronic form, it is called *gleet*, and often resists most obstinately, for months or even longer, every effort for its removal.

Besides these varieties, the term *spurious* or *external gonorrhœa* has been given to a discharge of the same nature from the surface of the glans, or the lining membrane of the prepuce; some authors term it *balanitis*.

SIMPLE GONORRHOEA.

If it arises from simple local or constitutional irritation, such as teething, the use of bougies, violent horse-exercise, a blow on the perineum, &c., the only symptom will be a purulent discharge of a whitish colour from the urethra, for the most part unaccompanied with heat, pain, or ardor urinæ; but if it is a precursory symptom of gout or rheumatism, in which case it is called *arthritic gonorrhœa*, the presence of symptoms of local inflammation and of ardor urinæ will render the diagnosis between it and virulent gonorrhœa extremely difficult. The discharge, which in the case of gout is supposed to arise from a superabundance of uric acid in the urine, will disappear immediately upon the development of the disease itself.

In this affection scarcely any special treatment is required, the removal of the cause of irritation being generally quite sufficient; but if necessary, recourse may be had to mild injections, laxatives, and such remedies as the state of the body may indicate.

Sir Astley Cooper has in his lectures strongly pointed out the importance, in a medico-legal point of view, of distinguishing accurately between this and the venereal or virulent form of the disease, especially in cases where it is asserted that a rape has been committed on very young children; the only ground of such accusations often being the

existence of a discharge from the vagina of the child. The possibility, therefore, of this being of a harmless nature, and not the consequence of sexual intercourse, must always be kept in mind.

VIRULENT, OR VENEREAL GONORRHOEA.

Cause.—This form of gonorrhœa is produced by the application of a specific irritant or virus to the surface of the mucous membrane of the urethra or of the vagina; such application occurring usually, but not necessarily, during sexual intercourse.

Nature of the Virus.—This virus is essentially distinct from that of syphilis. The experiments of John Hunter seem, indeed, to disprove this; but they have since been carefully repeated by Benj. Bell and others with an entirely opposite result; and M. Ricord of Paris has completely set this question at rest by his numerous and well-conducted researches.¹ Out of five hundred and forty-nine cases, occurring in his male and female wards, of gonorrhœa uncomplicated with chancre, and one hundred and twelve cases of chronic gonorrhœa or gleet, all of which were subjected to a test of *inoculation* in other parts of the body, *not one* produced the characteristic pustule which he invariably found to result from inoculation with matter from chancre in any of its forms during the period of infection. The circumstance of gonorrhœal matter having by inoculation produced chancres in the experiments of Hunter and others, M. Ricord attributes to the presence of concealed chancres (chancres larves) in the urethra, which he has shown to be a frequent complication. It is right, however, to state that the late Mr. Carmichael, of Dublin, continued to adhere to the opinion, that gonorrhœa virulenta produces the same constitutional effects, and is therefore identical in its nature with that mild form of chancre which precedes the papular eruption. But in his lectures,² whilst treating upon this subject, he has not taken into consideration the possibility of the existence of concealed chancres, which M. Ricord has pointed out in *every one* of the five cases quoted by Carmichael in support of his own theory, and which, if acknowledged, would reconcile his view with that generally received, namely, that the gonorrhœal virus is essentially distinct in its nature and effects from that of syphilis.

Period of Development.—The time at which the discharge first makes its appearance varies, but is generally from the *fourth* to the *seventh* day after infection. Occasionally it shows itself earlier, even in twenty-four hours, of which Sir A. Cooper mentions an instance; sometimes after a much longer period. In this latter case, however, it is often retarded by the co-existence of the premonitory symptoms of another disease, such as fever, on the recession of which disease it may immediately appear.

Its *duration* is very variable, and cannot be predicted from either the nature or the severity of the symptoms. It often runs its whole course

¹ "In the Lock Hospital of Edinburgh, Ricord's experiments have lately been repeated in a number of instances with nearly similar results."—Sir George Ballingall's *Military Surgery*, p. 425.

² *Clinical Lectures on the Venereal Disease*, by R. Carmichael, 1842.

in a few weeks ; at other times it lingers on for months, or even years, constituting what is termed gleet.

The following additional facts respecting gonorrhœal infection appear to be well established. 1. The disease is not communicable, by sexual intercourse *before* the discharge appears. 2. After the discharge is established, if the urethra be previously washed out by means of a syringe, it is not probable that the disease will be communicated. 3. The matter possesses the power of infection for an indefinite period ; Titley records the case of a girl communicating the disease on the first night after her leaving the Magdalene, where she had been for twelve months. 4. Two people having gleet may have intercourse with impunity ; but either of them will communicate gonorrhœa to a sound person. 5. The violence of the symptoms depends much upon the habit of body, the scrofulous diathesis greatly increasing their severity ;—thus the same woman may give a very mild form of the disease to one man, and a most severe form to another. 6. The first attack of the disease is always the most violent. 7. The disease is now much milder than formerly.

Symptoms.—At first there is merely a slight uneasiness and swelling along the anterior and under portion of the penis, with a tickling, teasing sensation over the glans and anterior portion of the urethra, the lips of which are found to be slightly red and turgid. Upon squeezing the glans a small quantity of a whitish muco-purulent matter exudes.

In a few days, the time varying according to the irritability of the constitution, the uneasy tickling sensation gives place to pain, which is often remarkably severe. There is an abundant discharge of yellowish pus, with scalding pains (ardor urinæ) during micturition, the calls to which are very frequent. The urethra, in consequence of the inflamed state of the mucous membrane, is much narrowed, causing the urine to be voided in a stream much smaller than usual, and sometimes forked, by reason of bands of lymph stretching across the interior of the canal. There may also be painful erections during the night. The pain progressively increases, and the matter discharged becomes greenish, or perhaps mixed with blood ; and besides the painful erections, chordee may now supervene. This term is given to a distorted condition of the penis, in which it is curved downwards, or to one side during erection, owing to the circumstance that inflammatory effusion into the corpus spongiosum prevents equal expansion with the corpora cavernosa. The inflammation may extend externally over the glans and membrane lining the prepuce, causing effusion into the cellular tissue between it and the integument, narrowing the external orifice, and giving rise to phymosis ; or, if the prepuce had been previously retracted, to paraphymosis.

This is the general progress of a moderately severe attack of gonorrhœa. In some cases, however, the inflammation extends along the course of the lymphatics to the inguinal glands, there causing bubo ; or backwards along the urethra to the membranous or prostatic portions, the neck of the bladder, or the bladder itself. The testicle may likewise become involved. Each of these complications will, however, require a separate notice.

Treatment.—The progress of gonorrhœa may be divided into *three*

stages—the *inflammatory*, the *suppurative*, and the *chronic*; in each of which an entirely different mode of treatment is indicated. Some short time, however, generally intervenes between the first appearances of the gonorrhoeal discharge and the accession of the inflammatory stage; and it has been recommended, upon high authority, to take advantage of this interval and check the disease at once, by throwing into the urethra strong injections of the nitrate of silver—ten grains to an ounce of water. This plan, however, is no doubt attended with considerable risk, as it may excite high inflammation of the urethra extending perhaps to the bladder. Dr. Titley and Mr. Carmichael agree in strongly deprecating the practice; Ricord, Arnott, and many others, strongly recommend it. It is called the *ectrotic* or *abortive* treatment, to distinguish it from the *curative*; and the time for its employment is limited to the nascent period of the inflammation,—the object aimed at being to prevent the development of the disease.

Dr. Arnott's mode of employing this treatment is as follows:—About a couple of drachms of a solution of the nitrate of silver, in the proportion of twelve grains of the salt to an ounce of water, is thrown into the urethra by means of a glass syringe; the penis being at the same time elevated and compressed about two inches from the orifice, thus insuring complete application of the solution to the urethral membrane within this range, and no further. The solution is retained within the urethra for not less than half a minute, and no urine is to be passed for half an hour after the injection. The immediate visible effect of the application is the formation of a coagulated film on the surface of the urethral membrane; and the diminution of pain which the patient experiences during micturition is probably to be attributed to the protection thus afforded to the abnormally sensitive membrane. It is also thought that the effects of the application may be partly attributed to the well-known action of the nitrate of silver in subduing crescent inflammation. Dr. Arnott thinks that this proceeding is open to only one objection, namely, that the period of its applicability is limited to a stage of the disease which usually excites but little attention.

Ricord, while he advocates the adoption of the abortive treatment, admits, as the result of his own experience, that although it has many advantages, it has its drawbacks and unpleasant consequences. He recommends that the urethra should not be compressed during the injection, and that the abortive treatment should also include the internal use of copaiba and cubebs in large doses. Injections modify and create a new action in the mucous membrane, and copaiba and cubebs, by yielding their principle to the urine, contribute powerfully to render that modification more effective. In the female syphilitic ward of the Royal Infirmary of Aberdeen, I have not had opportunities of trying the effect of ectrotic treatment, because the period for its employment is over before patients present themselves for admission: and my opportunities of forming an opinion from personal observation in males in private practice have been too few to enable me to arrive at a decided conclusion: but in the very limited number of cases in which I have employed it, I adopted Dr. Arnott's method, and had every reason to be satisfied with the results.

If the disease remain and progress after one, or at most two injections, the continuance of this treatment must be deemed inadvisable.

With regard to curative treatment, an entirely different mode is indicated in each stage.

I. *Inflammatory Stage*.—A suspensory bandage should be used from the commencement. Rest, attention to cleanliness about the parts, low diet, abstinence from all stimulating drinks, with the use of antimonials in nauseatory doses, must be strictly enforced. If the inflammatory symptoms run extremely high, with much constitutional disturbance, it may be necessary to have recourse to local depletion, and that very freely, a dozen or twenty leeches being applied to the perineum or groin. It would not be advisable to apply them to the penis itself: for if the gonorrhœa should be complicated with concealed chancres, the leech-bites would become infected, and the disease be considerably aggravated. Phymosis might also be the result of such an application, from infiltration of the cellular tissue. The patient should drink largely of diluents, such as barley-water, linseed tea, solution of gum arabic, &c.; these tend to diminish the irritating quality of the urine, and thus modify some of the distressing symptoms. To mitigate the ardor urinæ, if very severe, about twenty drops of liquor potassæ with thirty drops of tincture of hyoscyamus, or five grains of ext. conii, may be given in camphor mixture, three or four times a day, with much benefit; emollient fomentations being at the same time applied to the penis. If painful erections or chordee supervene, a most efficient remedy is camphor with opium, which may be given in the form of pills at bed-time. During the attacks, cold should be applied to the penis and the feet. The paroxysm is often checked by the patient getting out of bed, and putting his feet upon the cold floor; but if these means do not succeed, an opiate enema should be given, or a grain or two of solid opium introduced within the rectum. The bowels must be kept moderately open, by means of saline purgatives; but smart purging is to be avoided, because irritation of the rectum increases the pain of the urethra.

By these means the inflammatory symptoms, even if of considerable severity, may be subdued; but in most cases, such active treatment is unnecessary. The inflammation is generally slight, and in a few days gives way to rest, cleanliness, low diet, the free use of antimonials, liquor potassæ, demulcent drinks, with fomentations and support of the parts. The treatment must then be altered, and such remedies adopted as act favourably upon the inflamed mucous membrane.

II. *Suppurative Stage*.—The inflammatory symptoms being much checked, and the discharge having assumed a purulent character, even if considerable ardor urinæ be still present, the use of copaiba or cubebs should be commenced, the antiphlogistic regimen and rest being at the same time strictly enforced.

These medicines seem, by the principle they yield to the urine, to exert a favourable action upon the urethra itself; since, when the seat of gonorrhœa is the glans, vagina, or vulva, they appear to be of no service. The balsam of copaiba may be given alone, or on sugar, or floating on water, in doses of about thirty-five drops three times a day; but, as it is then apt to excite nausea, and other disagreeable symptoms, it

is better to give it in the form of emulsion, combined if necessary with diuretics. The following is a useful formula for its administration,—a wine-glassful being given night and morning.

R	Bals. Copaibæ	3vj.
	Mucilag. Acaciæ	3vj.
	Spir. Æth. Nitrosi	3ij.
	Sacchari Albi	3ss.
	Aquæ Cinnamomi	3vj.
Fiat Mistura.		

Another very convenient form of its administration is in pills, made by mixing the balsam with one-sixteenth part of its weight of calcined magnesia. Dr. Titley strongly recommends Morson's soluble extract of copaiba, one drachm of which, dissolved in eight ounces of boiling water and strained, forms an agreeable mixture, and is one of the best forms of exhibiting this medicine. The gelatinous capsules, although they answer the purpose of introducing the balsam into the stomach without being tasted, do not prevent the consequent nausea, and the purity of the copaiba cannot be relied on when disguised in this way.

Cubebs when *fresh ground* and *pure* are undoubtedly of great service in this disease. They may be given two or three times a day in water or milk, in doses of half-a-drachm, increased afterwards to one or two drachms, a grain or two of nitrate of potass being often added advantageously. If the discharge is not suppressed in eight or ten days, the cubebs will have no effect, and may be discontinued. In successful cases the beneficial results generally appear in two or three days, and may be known by the discharge first assuming a *ropy* character, and then ceasing altogether.

Injections.—A considerable number of days must be allowed to elapse after the subsidence of the inflammatory symptoms, before injections can properly be used; then, however, they are often of the greatest service. Those most in use are, solutions of the diacetate of lead, sulphate of zinc, and nitrate of silver; the last is the most efficient, but must be used very cautiously at first, commencing with a quarter of a grain to an ounce of water, and gradually increasing it to one or even two grains. The diacetate of lead, and sulphate of zinc may be used as strong as two grains to the ounce from the very commencement, their strength being gradually increased, if necessary. These injections should be used two or three times a day; if, however, they cause pain, they must be diluted; and if the discharge should stop suddenly, or irritation of the urethra be excited by their use, they must be altogether discontinued.

By persevering in the use of these remedies, the gonorrhœa in most cases gradually disappears. To prevent its return, the injections must be still used for some days, though with less frequency, and of diminished strength, and after that time they may be entirely discontinued.

In some instances, however, the discharge still continues, assuming a chronic form, and constituting gleet.

III. *Chronic stage or gleet.*—All inflammation has now disappeared, but the discharge continues, accompanied perhaps with slight ardor urinæ; or if it ceases for a few days, it returns again and again without any apparent cause. This state may depend upon relaxation, or perhaps upon the presence of stricture. If the latter be detected, it must

be treated accordingly. In this stage the use of injections must be continued, their strength being increased, if necessary; and if they are *frequently changed*, the desired effect is so much the more likely to be produced.

M. Ricord strongly recommends an injection of a solution of iodide of iron, commencing with one grain to an ounce of water, and increasing it gradually till it has some effect upon the discharge. This remedy I have found very useful. Generous diet, and cold ablutions are also useful in this stage; but perhaps the best treatment is to pass a bougie several times a day, following up its use by that of stimulating injections. This proceeding at first increases the discharge, but its quality is speedily altered, and at length it ceases altogether. The least irritation or irregularity of life, is, however, very apt to induce its return.

Cantharides, taken internally, in the form of tincture, are often of great service, and may be given in doses of fifteen or twenty drops, twice or thrice a day. This dose should be increased until pain and slight strangury be excited in the urethra and neighbourhood of the pubes. The discharge will then be found to have assumed a purulent character, and will gradually subside as the medicine is discontinued.

GONORRHOEA IN WOMEN.

If the discharge proceed from the *urethra*, the same plan of treatment must be pursued as in the gonorrhoea of males; but its seat is usually the vulva and vagina, often indeed involving the cervix uteri. Out of seventy-two patients in the Female Lock Ward in the Aberdeen Royal Infirmary, only three had the urethra affected.

The symptoms are, inflammation and tumefaction of the parts, with pain and scalding at the times of micturition, the latter symptoms appearing most distinctly when the urethra is the seat of the disease: the discharge stains the patient's linen of a greenish yellow colour, and is often very abundant. Upon examination with the speculum, superficial excoriations are often perceived upon the cervix uteri, or within the vagina, and sometimes infiltration takes place to a considerable extent into the cellular tissue of the labia and surrounding parts, causing great œdema, and occasionally abscess and sloughing in these situations.

If a case come under treatment *before the commencement* of the inflammatory stage, the urethra not being involved, it may be checked at once by injecting a strong solution of nitrate of silver (ten grains to an ounce); but as this is seldom the case, the antiphlogistic treatment must be employed until the inflammatory symptoms have subsided, warm emollient fomentations and injections being also used if the pain is severe. Should abscess of the labia or external parts ensue, the matter must be evacuated as speedily as possible by a large opening. As soon as the inflammation is subdued, astringent and stimulating injections should be employed. The decoction of oak bark or galls, solutions of sulphate of zinc or alum of considerable strength, are of great service; but perhaps the best is a solution of nitrate of silver, two or three grains to the ounce: the solution should be injected frequently; or, which will be found still more efficacious, the vagina should be plugged with lint dipped in it, and changed two or three times a day. This plan, recommended by both Ricord and Carmichael, seldom fails

to check the discharge very shortly; it seems to answer two purposes, both acting as a local astringent, and separating the parietes of the vagina, thus removing a constant source of irritation to the sound parts, and insulating the diseased portions. It often happens, however, that notwithstanding these applications, the discharge still continues. In this case the speculum should be used, and the os uteri examined, as it is often found that excoriations or ulcerations exist at this part, and by their constant irritation keep up the discharge. If such be discovered, they should be cauterized with a pencil of nitrate of silver, which M. Ricord recommends also to be gently carried over the vagina itself. This plan will seldom be found to fail.

EXTERNAL, OR SPURIOUS GONORRHOEA.

Balanitis of some authors, Gonorrhœa Præputialis of others.

These terms are used when the gonorrhœa proceeds only from the glans penis, or from the lining membrane of the prepuce.

Rest, moderate diet, and cleanliness, are often sufficient of themselves to remove this affection; if not, and if no phymosis exist, the prepuce should be drawn back and the parts gently cauterised with a pencil of nitrate of silver, this being repeated every two or three days till the cure is effected. If, however, phymosis be present, accompanied with considerable inflammation, leeches applied to the groin, and emollient fomentations to the affected part will be necessary; and as soon as the inflammation has been subdued, the proper operation must be performed for removing the phymosis, as it tends to keep up the discharge by constant irritation. Should any treatment be necessary after this, the gentle cauterising of the part as above directed, or the application of a strong solution of nitrate of silver between the glans and the prepuce will check the discharge.

Copaiba and cubebs seem to have no influence on this form of gonorrhœa.

INFLAMMATION OF THE MEMBRANOUS PORTION OF THE URETHRA.

Inflammation of the membranous portion of the urethra is often the consequence of an attack of gonorrhœa. When this occurs, the symptoms become more marked, especially the ardor urinæ; the whole penis is much swollen; the patient is exceedingly distressed with chordee; the discharge becomes fetid, sometimes tinged with blood; any pressure upon the membranous portion of the urethra causes pain to be felt as far back as the anus; the testicle is usually tender, and sometimes swollen.

Local bleeding, the application of poultices and fomentations to the perineum, and, general bleeding, if requisite, constitute the treatment to be employed; and, if matter form, a free vent must be given to it externally, as soon as its presence is detected.

INFLAMMATION OF THE PROSTATE GLAND.

The gonorrhœal inflammation may extend to the prostate gland. This is marked by the cessation of the gonorrhœal discharge, by pain and a sensation of weight at the neck of the bladder, with continual irritation and desire to pass water, tenesmus, weight and uneasiness in the peri-

neum, and tenderness of the gland itself, discoverable on examination through the rectum.

If the attack be violent, complete retention of urine will ensue, with great pain from pressure of the contents of the bladder upon the inflamed gland. Not unfrequently abscess is formed, the symptoms of which are at first very obscure, slight hardness and fulness of the perineum being often the only indication of its presence; and it bursts sometimes internally into the urethra, or into the rectum, but more frequently externally.

The constitutional symptoms are those of severe inflammatory fever; rigors generally supervening when abscess occurs.

Treatment.—Local depletion by means of leeches; and general depletion also, if the inflammation run high, must be employed; the bowels must be kept open to prevent irritation from the accumulation of fæces; and if there be much fever, antimonials should be given. Sir B. Brodie recommends calomel, given so as to affect the system slightly. To relieve the pain a warm bath is of great service, and opium may be administered per anum in the form of enema; and the urine, if retention takes place, must be drawn off by the gentle introduction of a small catheter.

If, in spite of every effort, suppuration ensue, fomentations and poultices must be applied to the perineum, and the matter evacuated by plunging a bistoury deep through the intervening structures, immediately on the detection of fluctuation in the perineum.

Sometimes, however, the abscess bursts into the urethra; the patient must then be confined to the horizontal position; and to prevent infiltration or its consequences, a small flexible gum-catheter should be retained in the urethra for some days; or a silver one gently introduced whenever he desires to void his urine.

As this usually occurs in scrofulous habits, and often uncomplicated with gonorrhœa, the general health must likewise be improved by the administration of tonics and generous diet.

INFLAMMATION OF THE BLADDER.

When inflammation has extended to the bladder, its mucous membrane becomes inflamed, the gonorrhœal discharge ceases, the desire to make water is incessant, the irritation of the mucous coat causes a sensation of fulness even when the bladder is empty, and gives rise to constant straining to effect its evacuation. The pain, however, is most intense when the bladder is distended, and a diagnostic mark is thus established between this affection and calculus. The urine deposits a sediment of a mucous, purulent, or muco-purulent character. Pain and tenderness are felt in the hypogastric region, and symptoms of considerable irritative fever.

Treatment.—This consists of perfect rest in the recumbent posture, general depletion if the symptoms be extremely severe, the application of leeches to the hypogastrium, the use of hip baths and warm fomentations, and the administration of gentle laxatives, with opiate enemata to relieve pain. If the urine is acid, saline medicines should be given, and calomel combined with opium several times daily; if alkaline, Sir B.

Brodie recommends fifteen or twenty drops of the vinum colchici three or four times a day. Should the inflammation depend upon a metastasis of the gonorrhœa, it will most probably cease on the return of the urethral discharge, which should, therefore, be promoted by warm emollient fomentations and the hip bath.

CHRONIC INFLAMMATION OF THE BLADDER, OR CATARRHUS VESICÆ.

Constant desire to pass water, caused by irritation of the mucous membrane, constitutes at first the principal symptom of this affection. After it has existed for some time, the urine becomes loaded with a grayish, ropy, tenacious mucus, sometimes tinged with blood, giving a highly alkaline reaction, and forming a glairy deposit on cooling, often nearly equal in quantity to the urine itself, which is much darker than natural, and emits an offensive ammoniacal odour. Sometimes also streaks of phosphate of lime are deposited with the sediment. This chronic state of inflammation is rarely a primary disease, being generally a consequence of calculus, stricture, or enlarged prostate disease of the rectum.

Treatment.—The exciting cause must be removed or modified, before a cure can be effected. Rest in the recumbent posture should be prescribed, with the pelvis raised, and opium administered, either by the mouth or as an enema, to relieve pain, together with gentle laxatives. Bleeding, either local or general, unless the inflammation runs very high, seems only to aggravate the symptoms by reducing the patient's strength, and mercurials are, for the most part, worse than useless. Counter-irritation on the hypogastric region in general affords relief.

Buchu and mineral acids are often useful. The *uva ursi* and *pareira brava* have been strongly recommended in this disease, the latter especially, by Sir B. Brodie, in the form of decoction, made by boiling half an ounce of the root in three pints of water down to one pint, and given in doses of eight or twelve ounces daily, with the addition of small doses of tincture of hyoscyamus and of the mineral acids, if a disposition to deposit phosphates exist. Copaiba, cubebs, and the muriated tincture of iron, have often a beneficial effect when given in small doses; and when the inflammation has greatly abated. As the cure progresses, it has sometimes been found advantageous to use simple injections of tepid water, slightly acidulated by the addition of ten drops of the diluted nitric acid to two ounces of warm water. If, however, pain or irritation be excited by their use, they must be at once discontinued. The beneficial effects of this proceeding have always appeared to me to be temporary. The best means for washing out the bladder, is a double catheter with a syringe adapted to one of the orifices. Rest, the recumbent posture, with the pelvis raised, opiate enemata, counter-irritation on the hypogastrium by means of the nitrate of silver, pareira with the mineral acids and tincture of hyoscyamus, the regulation of the bowels by small doses of castor oil, and a regimen rather generous than otherwise, are the remedies most generally useful.

[Injecting the bladder with a solution of nitrate of silver, will be found to be attended with the same beneficial results which follow its application in other diseased mucous membranes, and the injection of a

solution of the sulphate of morphia, when the pain is distressing, produces great relief.—ED.]

WARTS.

Preputial gonorrhœa frequently gives rise to warts, the position of which may be any part of the surface of the glans and prepuce. They vary much in size and number, being sometimes few and small, sometimes large and covering the whole of the parts. If few and small, they soon disappear under the repeated application of the sulphate of copper; but if large, the preferable proceeding is removal by scissors, followed by occasional application of the sulphate of copper.

PHYMOSIS AND PARAPHYMOSIS.

In most instances the prepuce can be easily retracted over the glans even during erection; in some cases, however, this is impracticable, and such a stage is termed phymosis.

It may be either *congenital* or *accidental*. In the latter case it is often produced by inflammation, and consequent swelling of the prepuce from an attack of gonorrhœa, by the cicatrisation of ulcers, the presence of warts, &c.

When the phymosis exists only in a slight degree, no great inconvenience is felt, nor is any special treatment requisite; but when it occurs to a greater extent, the matter secreted collects beneath the prepuce, giving rise to considerable irritation, and to a discharge, resembling gleet, which often excites ulceration. If the orifice is very much contracted, much pain and suffering are experienced in passing water. If inflammation arise, the prepuce becomes enormously distended, and by its mechanical pressure frequently causes great pain.

When inflammation occurs, the most active antiphlogistic remedies must be adopted. Fomentations and poultices must be applied, and

Fig. 217.



Fig. 218.



suspension of the part resorted to, together with antiphlogistic treatment; and should the inflammation still continue unchecked, or retention of the urine take place, or should the phymosis depend on warts, on obstinate or irritable sores, or on an ulcerated condition of the sur-

faces of the prepuce and glans, the prepuce must be slit up by an operation. This is effected by inserting a director by the side of the frænum, introducing a sharp-pointed bistoury upon it, transfixing the prepuce and slitting it up, one or two small sutures being then passed through the edges of the wound to prevent the separation of the internal and external integuments. The unseemly appearance of the flaps is soon almost entirely removed by interstitial absorption. If the phymosis depend upon too great length of the prepuce, which not unfrequently happens, especially when it is *congenital*, this may be drawn forwards from the extremity of the glans, and a portion of it removed by a circular incision—the same precaution being afterwards taken to secure the adhesion of the integuments and lining membranes by slight sutures.

An opposite condition of the prepuce often exists, where, having been drawn back over the glans, it is incapable of being returned. This is called paraphymosis.

The cause of this is in almost every instance a partial phymosis. When it assumes this condition, it acts as a tight ligature, constricting the urethra and impeding the return of the blood from the glans, which in consequence becomes oedematous and inflamed, and, unless the strangulation is quickly relieved, gangrene ensues.

When the constriction is only slight, it will yield to the local application of cold and manipulation of the same nature as the taxis; but if this fail, the constriction must be divided; and this is best effected by depressing the penis, separating the swellings behind and before the constriction, and with a sharp-pointed curved bistoury dividing the stricture. The symptoms will be at once relieved, although it may not be practicable to return the prepuce immediately after the operation.

PERMANENT STRICTURE.

Exciting Causes.—I have included stricture under the head of consequences of gonorrhœa, as this is one of the most frequent exciting causes. It may, however, arise from any source of urethral irritation, such as mechanical injury, the use of injections of too stimulating a character, calculus in the bladder, the presence of lithic acid or of phosphatic deposit in the urine, or contraction consequent on ulceration of the urethra, however such ulceration may have been induced.

Seat of Stricture.—Stricture may occur at any situation anterior to the prostatic division of the urethra; but its most frequent sites are at the bulb, at the natural bend of the penis when pendulous, in the membranous portion of the urethra, an inch behind the orifice itself, constituting what is called official stricture. The two first-mentioned sites are the most common. In seventy-seven out of ninety-eight examples of stricture, referred to by Mr. H. Smith, the constriction was found in the bulb, or in some part between it and the orifice; and in twenty-one, in the membranous division of the urethra.

Symptoms.—The urine is observed to pass in a gradually diminishing stream, which at length becomes twisted or forked. A few drops are left in the urethra, after all the urine seems to have been expelled. There is, especially after exposure to cold and damp, a sense of scalding and irritation along some part of the urethra during micturition, the calls to

which are very frequent. The bladder becomes very irritable, and the urine on cooling deposits a flaky mucus. Matter resembling that of gleet is discharged from the urethra, mingled sometimes with blood or pus, indicating the presence of an ulcer or abscess. If the stricture be of long standing, the induration of the part constricted may be felt externally. Besides these local symptoms, there are often tenesmus, hemorrhoids, pains in the loins, chronic enlargement of the testicle, herpetic eruption on the glans and prepuce, shooting pains in the perineum, and in severe cases, complete retention with extravasation of urine, or abscess and fistula in perineo. The great and constant irritation preys upon the constitution, and low hectic fever comes on, the countenance assuming a pallid copperish hue.

State of the Parts.—Permanent stricture may be the result of a low degree of chronic inflammation, in consequence of which lymph is effused to a greater or less extent beneath the mucous membrane of the urethra, the calibre of which is thus diminished; and this lymph, after the lapse of some time, becomes indurated. Or, it may depend upon the formation either of a membranous septum stretching across the urethra and pierced by a small aperture, or of a simple band stretching from side to side. In this last case it is termed a *bridle stricture*.

In a case of old stricture, the mucous membrane behind the contracted part may become inflamed and ulcerated; and this condition may extend to the cellular tissue, and an abscess be formed, bursting in the perineum and constituting fistula in perineo; or, in consequence of the great dilatation of the urethra behind the stricture, that canal itself may burst, and the urine become extravasated into the perineum. The prostate may become enlarged, and the bladder hypertrophied; chronic cystitis, or even hernia vesicæ, or first functional derangement, and afterwards organic disease of the kidneys may ensue.

Treatment.—Of the various methods of treatment the most suitable are the three following—the use of the metallic bougie—that of the silver catheter—and free division of the stricture by the knife, as proposed by Professor Syme. In certain classes of cases, each of the methods has its special advantages. In the great majority, assuredly, the most suitable by far is the judicious use of metallic bougies.

A bougie is selected of such size as is likely to pass without much difficulty. Having been dipped in warm water and oiled, it is to be passed down, and, on arriving at the stricture, to be steadily but very gently pressed onward, with the view of penetrating the stricture. This having been accomplished, it should be allowed to remain for a few minutes, unless the patient complain of pain, in which case it must be at once withdrawn. In the use of the instrument, lightness of grasp and gentleness of pressure are requisite; for to press forcibly or to grasp tightly would occasion the risk of either pressing the stricture before the instrument, or of perforating part of the urethra. If unsuccessful with the bougie first employed, others should be passed down to the stricture in a series of gradually decreasing sizes, until one is inserted into the bladder.

When the stricture has been penetrated, the instrument remains fixed after the hand is withdrawn. If, therefore, the instrument resiles, it is

an evidence that penetration has not been effected. The first introduction of the bougie is in some instances attended with severe pain, faintness, and rigors; but these unpleasant symptoms are usually felt less at every succeeding operation. There is usually, also, after the first operation, ardor urinæ in some degree, together with considerable pain for some time at the stretched parts, and increased difficulty of passing water. The uneasiness and irritation caused by the operation generally subside in the course of two or three days. The operation should then be repeated, the surgeon first using the same bougie as before, then withdrawing it and introducing the next in size; and this proceeding should be resumed at intervals until the normal size of the urethra be attained, and the largest bougie can be introduced without any difficulty; after which a large one should be occasionally used at increasingly long intervals, until it be ascertained that there is no tendency to a return of the constriction. The cure is thus accomplished on the principle of dilatation, the effect of which in the first instance is mechanical, but ultimately it causes removal of the stricture by interstitial absorption. This mode of treatment is applicable to the great majority of strictures, and wherever applicable it ought to be preferred to every other method.

If, however, a stricture be very difficult to dilate—or if there be an irregular condition of the urethra from long continuance of the disease,—or a false passage, or great difficulty in effecting penetration,—or severe rigor following each introduction of the instrument,—or a threatening of retention of urine,—it will be preferable to introduce a silver catheter through the stricture, and retain it by tapes. The orifice of the catheter is generally kept closed, but it is opened from time to time for the evacuation of the urine. The pressure of the catheter gives rise to a certain degree of irritation and swelling, in consequence of which it becomes by and by very firmly constricted. The irritation produces a slight grade of inflammation, and a considerable discharge of matter usually ensues, followed by widening, relaxation, and absorption, by which means the desired result is in most instances very speedily obtained. The instrument having become perfectly loose is withdrawn, and, after a few days, a larger one may, if necessary, be introduced for a short time. In the class of cases mentioned above, this mode of treatment is found highly satisfactory; and, from what has been stated, the principle of its usefulness may be easily understood.

It must be admitted, however, that it is attended with much greater risk than the usual mode of treatment by the bougie, and should therefore be restricted to cases in which the latter is less suitable. It is seldom necessary to allow the instrument to remain above three days; and in some cases its use must be limited to a much shorter period.

Some surgeons prefer the flexible catheter, but as far as my own experience has enabled me to judge, the silver one is in most instances less irritating. Sir Benjamin Brodie recommends the use of a gum catheter, mounted on a strong unyielding iron stilet, with a flat iron handle like that of a sound or staff. He says: "Being so mounted it is more readily directed into the bladder than when mounted in the usual way on a thin flexible wire. When the gum catheter has entered the blad-

der, withdraw the stilet, and leave the catheter with a wooden peg in its orifice, which the patient is to take out whenever he has occasion to void his urine, it being at the same time secured by a suitable bandage. After three or four days you may withdraw the catheter for twelve hours; or if much suppuration is induced in the urethra, you may withdraw it for a longer period; then introduce a larger catheter than the first, and thus you may, in the course of ten days or a fortnight, dilate a very contracted urethra to its full diameter."

In both these methods of proceeding, namely, by the bougie and by the catheter, the principle of treatment is to induce absorption, the existing cause of which is mechanical dilatation.

Professor Syme has recommended a new proceeding for the treatment of permanent stricture, namely, free division of the stricture by the knife. The patient is put under the influence of chloroform; and the limbs having been separated from each other, a small grooved director is passed through the stricture; and the surgeon makes a free incision about an inch and a half long in the mesial line, and divides the textures external to the urethra over the situation of the stricture. A small straight bistoury is then sent into the groove of the director behind the stricture, and by bringing it forward the whole of the contracted part is divided. A No. 7 silver catheter is introduced through the urethra, and retained for twenty-four hours. Professor Syme has published the results of his proceedings, which have been very satisfactory; and he states that the advantages of this mode of treatment are, that it is speedy, safe, and effectual. He considers it the best that could be applied, where the stricture is very obstinate and contractile. For the adoption of this method of treatment it is essential that the stricture be not impassable; but Professor Syme contends that, according to his experience, no strictures are impassable.

On this subject Professor Syme remarks:—"So long back as 1844, I expressed my persuasion that no stricture was truly impermeable, the exit of water being a certain sign that instruments might, through sufficient care be introduced. This principle of practice was obviously of great importance, since conviction of its truth would obviously lead to much more prolonged and careful exploration of the passage than would be thought requisite, if belief in the impermeability of stricture was entertained. For my own part it was frankly confessed, that, while sharing in the doctrine of impervious urethras, I had occasionally found them so, and performed the old operation, while ever since adopting the principle that every stricture might be permeated by instruments through time and care, I had not, either in public or private practice, met with one that proved incorrigibly obstinate."

This treatment is only suggested as a remedy for strictures which are otherwise incurable. It is perfectly certain that, in many cases, this mode of treatment has been exceedingly satisfactory: while in a very few the cure has not been permanent—a circumstance which may have been owing to neglect of the judicious precaution of occasionally introducing the bougie.

Should a case, however, occur, in which an entrance cannot be effected either by the bougie or by the catheter, the preferable mode is to cut

down upon the stricture and divide it. This, however, is a proceeding which no surgeon is justified in adopting, except under very urgent circumstances, namely, where there is a stricture which cannot be penetrated, together with retention of urine.

The operation consists in introducing a catheter to the stricture, making a direct incision in the raphe down to the dilated urethra behind the stricture, opening the urethra and dividing the stricture by cutting it from behind forwards upon the catheter, which should then be sent back into the bladder and retained. Proper means should then be taken to promote the healing of the wound.

Other methods of treatment, in which the cure is attempted on entirely different principles, are—subcutaneous division of the stricture; forcing a passage through the stricture, as recommended by many French surgeons: perforation of the stricture by a cutting instrument, commonly called the treatment by the lanceletted stilette, a method strongly advocated by Mr. Stafford for certain cases; and the treatment by the caustic bougie. In this last method, the caustic potass and nitrate of silver have each been used. The caustic has been applied by inserting it into the hollow end of a common wax bougie, but the best mode of its application is by the *porte-caustique* recommended by M. Lallemand. All these methods are liable to many and serious objections, and, in consequence, they need not here be described.

CATHETERISM.

No surgical proceeding can be more easily accomplished than passing a catheter in ordinary circumstances; and on the other hand, as has been acknowledged by the most eminent practical surgeons, there is not in the whole range of surgical proceedings a more difficult operation or one that requires greater skill, caution, and experience, than that of passing the catheter through what has been called an impermeable stricture.

1. *Ordinary Proceeding.*—When there is no difficulty, the catheter may be passed into the bladder in the following manner. The patient having been placed in the recumbent posture, a silver catheter having been selected, dipped in warm water and oiled, the surgeon takes hold of the penis with his left hand, and raises it up, introduces the point of the instrument in the meatus, with the handle directed to the belly, and gently slides the catheter onwards, keeping the point along the upper aspect of the urethra. The instrument glides onwards until its point engages itself in the part of the urethra embraced by the deep fascia, when the handle should be gently depressed, the point being still kept along the roof of the canal, until it glides into the bladder. In no part of this movement should the slightest force be used; and it is unnecessary even to hold the penis in the left hand, except during the introduction of the instrument into the meatus and anterior portion of the canal.

2. *Another Proceeding.*—The “*tour de maître*.” The instrument having been prepared for use, its point is introduced into the meatus and sent along the upper surface of the urethra, with its convexity directed upwards, until its point is beneath the symphysis, when the

catheter is made to perform a half turn from right to left, which brings the handle and concavity upwards. This manœuvre having been executed, the handle is depressed and by the gentlest effort the point is slipped into the bladder. The only advantage of this mode is, that if the patient be sitting or standing, the front of the abdomen does not prevent a desirable position of the handle of the instrument in the first part of the proceeding.

RETENTION OF URINE.

The principal conditions which give rise to retention of urine, together with the appropriate treatment, now come to be considered.

I. RETENTION FROM STRICTURE OF URETHRA.

Should a case of retention present itself, caused by a hard and gristly stricture situated in front of the scrotum, and should it be found impossible to penetrate the stricture by the usual gentle manipulation, in which the instrument is held lightly and pressed against the stricture without any force, the surgeon should take hold of the hard part between the forefinger and thumb of the left hand, and pass down the catheter to the stricture, and gently and cautiously effect penetration, and lodge it in the bladder. Should the stricture which causes retention be situated behind the scrotum, and should it be found impracticable to pass the catheter by the most cautious, gentle, and dexterous manipulation, the proper practice is to perform the old operation of sending back a catheter to the stricture, cutting into the dilated portion of the urethra behind the stricture, when the urine will escape, and dividing the stricture by cutting forward upon the point of the catheter, and sending it back so as to lodge it in the bladder. Such are the most advisable proceedings when retention is caused by stricture anterior to the prostate gland.

II. RETENTION FROM ABSCESS IN THE PERINEUM.

Occlusion of the urethra with consequent retention of urine is occasionally produced by abscess in the perineum. The proper practice in such circumstances is free direct incision, so as to evacuate the matter and remove the cause of obstruction.

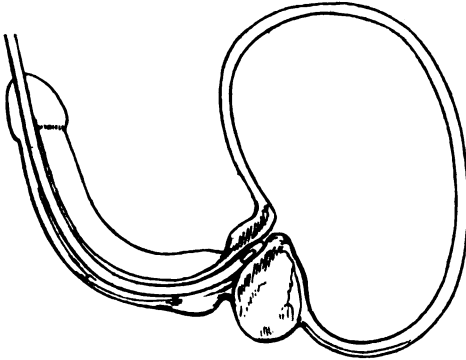
III. RETENTION FROM ENLARGEMENT OF PROSTATE GLAND.

Enlargement of the prostate gland is not unfrequently a cause of retention. A portion of the gland rising up at the commencement of the urethra acts as an obstacle to the passage of the urine. This cause of retention can in general be readily overcome by attending to the following precautions:—Using a very long catheter, with a large curve, and the point more than usually bent—and depressing the handle to a much greater degree than in performing catheterism in ordinary circumstances.

The accompanying wood-cut will show the importance of these directions. The unusual length of the catheter is necessary on account of the rising up of the bladder, and consequent elongation of the urethra. The peculiarity of form and the depressing of the handle admit of the

instrument being sent up in front of the obstruction, instead of pressing against the obstruction, as would be the case in using an ordinary catheter in the usual way. Should all efforts to introduce the instru-

Fig. 219.



ment prove unavailing, the least hazardous proceeding is to perforate the obstruction, in doing which the greatest care must be taken that the point of the instrument be lodged in the prostatic portion of the urethra, and that it be sent in the proper direction into the bladder. Puncturing the bladder from the rectum, which can be safely done for the relief of retention when the prostate gland is not diseased, is unsafe in the conditions now under consideration. With regard to puncturing above the pubes, the risk of infiltration is so great that it ought not to be attempted. When it is necessary to penetrate the obstruction in case of a diseased prostate, the catheter ought to be allowed to remain in the bladder for some time; and in all cases of retention, a repetition of the operation is very soon requisite, as secretion of urine takes place rapidly, after the pressure on the kidneys, caused by the distension of the ureters, has been removed.

IV. RETENTION FROM PARALYSIS.

The detrusor urinæ may become paralytic in consequence of over-distension, injury or disease of the spine, or the feebleness of age. In addition to the treatment suitable to the state which has caused the paralysis, the urine must be drawn off twice in the four-and-twenty hours, to prevent discomfort and allow the weakened parts a chance of regaining tone.

SYPHILIS.

This term is used to denote various morbid appearances, which are arranged into two grand divisions, namely, the *local* or *primary*, and the *constitutional* symptoms of the disease;—the former consisting of certain ulcerations, commonly termed chancres, and consequent upon them, of swellings of glands, technically called buboes; the latter, which are sub-

Fig. 219. From Liston.

divided into the secondary and tertiary symptoms, consisting of various morbid affections of the skin, mucous membrane, periosteum, bone, and other textures.

LOCAL OR PRIMARY SYMPTOMS.

It must not be supposed that all sores on the penis are venereal; for that organ is, like other parts of the body, liable to irritation and inflammation; and common excoriation and ulcers may form on it as elsewhere. Neither must we conclude that all sores consequent on sexual intercourse are syphilitic, as excoriations may be produced by sexual intercourse, which originate in irritation, or in the contact of acrid secretions, not venereal or connected with the inoculation of syphilitic virus. Simple excoriations and common sores are distinguished by their history and appearance, and by the absence of the peculiar characters of the various forms of venereal ulcers.

Venereal ulcers do not form immediately on the application of venereal poison; a certain interval elapses, varying in duration according to the manner in which the virus is applied. When the surface to which it is applied is entire, ulcer rarely appears for five or six days, and often the interval is longer; but when it is applied to a broken surface, the appearances come on much more rapidly, the wound becomes painful, and in many instances decided symptoms of syphilitic ulcer are perceptible in twenty-four hours.

There are several kinds of venereal ulcers, which, though they all originate from a common cause, namely, the application of venereal virus, yet differ materially from each other both in the character of the primary sores, and in the subsequent constitutional symptoms. As the technical term, chancre, is, strictly speaking, applicable only to those ulcers which have a corroded appearance, many prefer the expressions primary sores, or primary ulcers. Primary venereal sores are of various kinds; but those which are most remarkable, and so clearly defined by their distinctive characters as to present no difficulty of discrimination, are the four following.

I. THE SIMPLE VENEREAL ULCER.

This,—called by some writers the common venereal ulcer, and by others the elevated ulcer,—is found more frequently on the internal surface of the prepuce, and in the sulcus behind the corona glandis, than in any other situations. It is often also met with on the glans, and usually there are more sores than one. When the sore results from the application of the virus to an entire surface, the first symptoms are itching and redness, followed by vesication, and the pustule gives way and discharges its contents either by the bursting of the cuticle, or by a portion of the scab becoming detached, and thus exposing the ulcer underneath. Such are the changes in the first or inflammatory stage.

The form of the ulcer is usually circular, or nearly so; its surface concave; its colour pale, surrounded by a bright inflammatory areola; the discharge rather ichorish; and the pain considerable. Such are the appearances during the second stage when the virus contained in the matter is most calculated to propagate the disease. In the next stage

the surface of the sore, instead of being depressed, becomes covered over with granulations, which are pale and flabby, and rise like a small fungus above the surrounding parts; the ring of inflammation also becomes indistinct. This is the third stage, or that of reparation or granulation, and is succeeded by cicatrization. By these distinctive characters, and by the absence of any surrounding induration, phagedæna, or elevation of the edges, the diagnosis is easily made out. When the sore originates from the application of the virus to an abraded surface, the part very soon becomes painful, a scab forms, and in the subsequent progress the appearances are as already described.

Treatment.—It is extremely desirable to arrest the progress of the disease as speedily as possible, since there is every reason to believe, that if the removal of the local disease be accomplished very early by the entire destruction of the part affected, a perfect protection is in the great majority of instances insured against constitutional symptoms. That the chance of securing this protection diminishes as the destruction is deferred, there can be no doubt; but if it be effected within the first two or three days from the commencement of the specific or inflammatory process, or perhaps at any time until near the period of the bursting of the matrix vesicle, while the disease is local, the constitution may be preserved untainted. It is now well known that the virus is contained in the discharge secreted during the second stage, and that this is consequently the period which is most favourable for the employment of the test of inoculation, and in which the constitution is so apt to be affected, or the disease to be communicated by sexual intercourse.

A principal object, therefore, of the surgeon will be to prevent the occurrence of that stage; or, to cut it short, if it be too late to prevent: in either case his plan will be to convert the sore into a simple ulcer by the entire destruction of the affected part; or, in other words, to institute the ectrotic treatment. Of the various means adopted for this end, that most generally employed is the application of the solid nitrate of silver, which should be applied so efficiently as to insure the complete destruction of the affected part. This is done in the first stage, not only with the view of stopping the disease, but also of affording a protection against constitutional sequelæ; in the second stage, only with the hope of cutting short the disease. This is the mode of destruction which I have generally preferred; and for after-dressings I have in many cases applied nothing but a piece of dry lint or charpie, and on the falling off of the scab have found the sore healed; in other instances I have used water-dressings. Professor Graves objects to the application of the solid nitrate of silver, if the sore be large, on the ground of its being apt to produce bubo, and recommends the following proceeding, which I have adopted in many cases with the happiest results:—"Provide yourself with a common-sized nicely pointed camel's hair pencil, and a solution of lunar caustic, twenty grains to the ounce; pour a drop or two of this on the cover of a book or on the table, and dipping the brush in a basin of water, cleanse the surface of the sore with it. Dry the sore then completely with a piece of lint, and rinsing the brush, squeeze out the chief part of the water, and, pointing the brush, you may then dip the extreme point of it in the drop of caustic solution, so as to take up

the smallest possible quantity of fluid, which you may then apply to the centre of the sore. When it has done acting, we may readily judge by the appearance of the surface whether enough has been applied, for the whole surface must be whitened; but it is not, as is usually imagined, proper to burn out the edges. It may be necessary to dip the end of the brush in the solution, and apply it to the sore a second or even a third time, pausing to observe the effects of such applications. By proceeding thus we destroy the diseased surface, and do not produce any inflammation likely to give rise to bubo."

Such is the treatment in the second stage; in the third, the immediate object aimed at is to repress the elevation of the granulations; and that can be very conveniently done by occasionally pencilling them very lightly with nitrate of silver, or sulphate of copper, and in the intervals applying to the part either simple water-dressings, or the solution of the sulphate of zinc, as the appearances may indicate.

II. ULCER WITH ELEVATED EDGES.

The situations in which this sore is most frequently found are on the prepuce, both on its internal and external surfaces, in the fossa behind the corona glandis, and on the corona glandis itself. It is also very frequently found at the margin of the prepuce, where it is apt to occasion phymosis. Its formation may take place very speedily after sexual intercourse, if the virus has been applied to an abraded surface, or not till after some days, if the surface has been entire.

The distinguishing peculiarities of this ulcer are, that the margin is elevated above the sore and the surrounding surface, and also slightly indurated; the surface is excavated and of a brownish raw colour, and of irritable appearance without commencing granulations. The discharge is thin, the pain is considerable, and in some instances the destruction by ulceration is somewhat rapid. Among the negative marks of distinction are the absence of phagedæna, and of induration of the base, or the surrounding parts. It is usual to find more than one sore at the same time. The treatment is the same as for the simple venereal sore.

III. THE HUNTERIAN OR TRUE CHANCER.

The ordinary sites of this ulcer are the glans penis, the frænum, the fossa behind the corona glandis, and the body of the penis. The first is the most frequent. The formation of this sore has been known to take place in one day, and, in some instances, to be delayed for weeks; but it is usually found about the third or fourth day, or from that to the seventh, after sexual intercourse. Its distinguishing peculiarities are, that after a pustule containing matter, an ulcer results, the form of which is circular, or approaching to circular; the edges either regular or very slightly indented; the surface much excavated without the appearance of granulations, and covered with a viscid ash-coloured substance; and the base hard, with this peculiarity, that the hardness is usually defined and terminates abruptly, instead of gradually blending with the surrounding parts. The progress of the ulcer is slow, indolence of action being a distinguishing peculiarity. By these peculiari-

ties, together with the negative signs, namely, the absence of phagedæna, and of a surrounding areola of inflammation, the diagnosis is easily made out. This ulcer, unlike the former, is in most instances solitary.

The treatment of this chancre is the same with that of the two former, except that a much more extensive destruction, by means of nitrate of silver, is necessary in order to insure the entire removal of all the parts affected with hardening, and the formation of a simple healthy ulcer on the separation of the eschar. Some surgeons have employed potassa fusa to effect destruction of the diseased parts; I have no experience of its use in these cases, having always preferred nitrate of silver, both because its application is attended with much less pain, and also because the extent of destruction is more easily regulated. Lint dipped in water, in the solution of the sulphate of zinc, or in the black wash, may be applied in the ordinary dressings, as the appearance of the ulcer may indicate. To the employment of mercury in the treatment of the primary sores, we shall refer in a future page.

IV. PHAGEDÆNIC SORE.

The three varieties, namely, phagedæna, or phagedænic sore, sloughing or gangrenous, and sloughing phagedæna, called by some writers the phagedæna gangrenosa, are so similar to each other in the circumstances in which they are found, in their symptoms and in their treatment, that it will be more convenient to describe them together than to assign a separate section to each. The term phagedæna, derived from *φάγω*, to eat, is well applied to this kind of ulcer, as there is the appearance of regular eating away, or destruction by phagedænic ulceration, without any attempt at granulation. This kind of destruction, though most commonly seen as a form of syphilis, is by no means confined to syphilitic disease.

Phagedæna, or a phagedænic ulcer, may be distinguished by the following peculiarities. The edges are extremely irregular and of a dark purplish appearance, a red colour extending a considerable way into the surrounding parts; they are exceedingly painful, and at parts inverted; the surface of the sore is uneven, and extends underneath the edges; it is of a livid or dark red colour, and together with the edges has a very irritable appearance. It is covered by a thin ichorish bloody discharge. The sore enlarges with alarming rapidity, and the destructive process may continue to be carried on either by ulceration alone, or, which is more common, by ulceration together with sloughing, so as to constitute the variety called by some writers, the sloughing phagedæna, and by others the phagedæna gangrenosa. In the other variety, namely, the sloughing sore, the destruction is by sloughing alone; the sore enlarges by the formation of one slough after another, and the surface of the sore on the separation of the slough, instead of presenting the appearance of granulations, has a raw, red, irritable appearance. These three varieties exhibit the same appearance of edges, and occur in similar circumstances; they differ chiefly in the appearance of the surface of the sore, there being in the phagedænic sore an irregular appearance of the surface, occasioned by the ulcerative process; in the sloughing phagedæna

the same appearance at some parts, and a wet ash-coloured slough at others; and in the sloughing variety a wet slough covering the sore. The characters of these ulcers are so peculiar that there can be no difficulty in distinguishing them from each other, or from any of the syphilitic ulcers formerly described. A high degree of constitutional disturbance attends each of these three varieties. The tongue is white, the skin dry, the pulse quick and small, with loss of appetite, prostration of strength, and the other symptoms of high irritative fever; which, when the disease is extensive and of long continuance, is apt, and sometimes quickly, to assume the typhoid type. Individuals whose constitutions have been rendered irritable by intemperance, by want of proper food or regular rest, by living in damp or confined situations, or by leading irregular lives, are those in whom phagedænic ulceration is most apt to take place, and in whom it is likely to proceed to the most alarming results. On this subject Professor Samuel Cooper says,—“The causes of phagedænic ulceration may frequently be traced to the condition of the individual's health; to his having neglected to restrict himself to proper regimen; to his having been guilty of excess; or to his having neglected some other kind of primary sore at its commencement.”

The treatment of these three varieties is both constitutional and local. The object of the former is to improve the general health, to increase the strength, and to allay the irritability of the system. The means to be employed must be regulated by the particular circumstances of each case. The skin should be kept in a soft state, the general irritability of the system and the pain of the sore allayed, and if the patient have restless nights, means must be taken to procure sleep. For the fulfilment of these indications many combinations of remedies may be serviceable; but that which is used by many practitioners, and which I have often employed with the happiest effects, is the liquor ammoniæ acetatis, combined with morphia, and given at bedtime, in doses proportioned to the age of the patient and the urgency of the symptoms. A most important indication is to promote a healthy condition of the digestive apparatus; the bowels should be carefully regulated, and the diet be most nourishing in quality and easy of digestion. The patient should be kept in an airy situation, the part kept at perfect rest, and everything guarded against which might exert any depressing influence or any untoward agency on the general system.

Such, in the great majority of cases, are the most important objects aimed at by constitutional treatment, but the use of other remedies may be indicated, and the surgeon in every case must act as the symptoms may suggest. As to local treatment, various modes have been adopted. An application, strongly recommended by Sir Astley Cooper, and often used, especially when the destructive action is not extremely rapid, is the nitric acid lotion, of the strength of from thirty to fifty drops to a quart of water. I have in many instances in my own practice, and in that of my friend and predecessor in this university, Dr. Ewing, seen this application used with the happiest effects in conjunction with the constitutional treatment above described. As soon as the character of the sore becomes healthy, simple dressings should be applied. Two

opposite methods, the one mild and soothing, the other of the most energetic character, have been recommended by different surgeons for the treatment of this ulcer. The former method, the object of which is, by soothing the irritability of the part, to diminish the inflammation and induce a more mild and healthy action, consists in the application of emollient and opiate poultices, or of emollient poultices, and opiate ointments to the affected part; the linseed poultice prepared with a decoction of opium is the application often preferred. Of the various applications employed in the energetic practice, the object of which is to destroy the whole of the diseased part, the pure nitric acid is the most frequently recommended. The sore should first be well dried, and the acid then applied by means of lint soaked in it, and in such a manner as to destroy not only the diseased surface, but also the margin and subjacent parts, in which violent inflammatory action is going on. The surface is very speedily converted into an eschar. If any of the acid should spread from the sore, it should be carefully wiped away, that the surrounding parts may not be injured; a powerful opiate should be administered to diminish the pain, and the application of poultices kept up to promote the separation of the eschar; after which the treatment should be changed for that which is proper in a simple healthy ulcer. As far as my own experience goes, I am decidedly in favour of the latter method of treatment, and invariably have recourse to it on finding that the soothing system has not had the desired result. In cases where the morbid action is not so violent, the application of the weak nitric acid lotion, together with mild poultices and suitable constitutional treatment, is often followed by the most beneficial results.

The above statements, it is hoped, will be sufficient to point out clearly the distinctive characters, and the treatment of the principal forms of primary venereal sores.

The Consecutive or Constitutional Symptoms of Syphilis are divided into two grand classes, the secondary and tertiary; the former comprehending certain eruptions on the skin, affections of the mucous membrane, and iritis; the latter, affections of bone, periosteum, certain tubercular affections, assuming in many cases the characters of rupia prominens, and ending in irritable sores, affections of the mucous membrane, and iritis.

SECONDARY AFFECTIONS.

The principal eruptions are the papular, the pustular, the scaly, and the tubercular.

I. THE PAPULAR ERUPTION.

The papular eruption, or venereal lichen, as it has been designated, is preceded by fever, which is attended with pains in the head, shoulders, knees, and larger joints, and sometimes in the chest, where a feeling of anxiety is at times experienced. The pains are most severe at night, and the febrile symptoms, which are at their height before the appearance of the eruption, do not cease when the eruption comes out, but

continue as long as successive crops appear. The eruption is of the papular form, the part being at first of a red colour, varying in brightness in different cases; by and by, however, there is the appearance of pustules with elevated tops, containing lymph or matter; and afterwards, when the eruption is on the decline, it presents in the desquamating stage a scaly appearance from exfoliation of the cuticle; the colour being in this stage much paler, and having a copper tinge. The time of the appearance of the eruption after the primary symptoms is very variable. In many examples the eruption is found all over the body, but it is usually most copious on the face, chest, back, and belly; and frequently, after having entirely subsided, it returns at very uncertain intervals, but each successive attack is in general less extensive, and accompanied with less febrile derangement. Passive inflammation of the conjunctiva is very frequently an accompaniment of this eruption; and it is almost invariably attended with inflammation of the mucous membrane of the throat, the back of the pharynx, the tonsils, and the fauces for the most part being red and swollen, and presenting a raw appearance, and often covered with an aphthous coating. There is difficulty of deglutition, and at times the glands of the neck become swollen. It is of the greatest practical importance not to confound the desquamating stage of the papular eruption with the scaly eruption to be presently described.

The exhibition of mercury forms no part of the proper treatment of this affection, experience showing that when taken *before* the appearance of the eruption it increases the fever and local pains, and when *after* its appearance, it seems to be followed by increase of the local pains, and recurrence of eruption. It is only after the desquamating stage is over, that its exhibition can be ventured upon with any advantage, and, indeed, without being injurious; and even then it is not essential, or even useful, except when given in small alterative doses, and combined with some antimonial, or with sarsaparilla. The treatment which is recommended by many authorities, and which I have found very satisfactory, consists in the strict employment of the antiphlogistic regimen, until all febrile symptoms have completely subsided; in purging the bowels very smartly at the commencement, and afterwards keeping them in an open state by cooling aperient medicines; in producing determination to the skin by saline, antimonial, and other suitable diaphoretic medicines, so as to promote the coming out of the eruption; in preserving the surface of the body warm; in enjoining confinement to the house while painful symptoms continue; in the occasional use of the warm-bath, the use of nutritious, but light and digestible food, and after the subsidence of the eruption and of all febrile symptoms, the employment of a course of sarsaparilla and iodide of potassium, with all judicious means for restoring the strength and improving the general health.

II. THE PUSTULAR ERUPTION.

In this, as in the former case, the appearance of the eruption is preceded by febrile symptoms, with local pains. In some persons successive crops, and also the coexistence of pustules in different stages, are

observable. The matter which forms, dries into which a superficial ulcer is concealed, the mildness absence of any tendency to spread, distinguish it from eruption. On the healing up of the ulcer and the scab, the cicatrix has a discoloured appearance. The is found useful as in the papular eruption.

III. THE SCALY ERUPTION.

The scaly eruption, as was noticed by Hunter, is sometimes preceded by efflorescence of the whole body, and presents, as Dr. Willan remarked, a mottled-red appearance of the skin, similar to that of *roseola anulata*; this, however, in a short time passes away, and leaves the skin covered with scurfs or scales. The scaly eruption usually exhibits the appearance either of syphilitic lepra, or of syphilitic psoriasis.

In syphilitic lepra the spots on the skin are of a circular form, of a reddish, or what is called a coppery colour; they are a little elevated above the surrounding surface, and the circumference of each spot is rather more elevated than its centre. The patches in general are distinct and at a distance from each other; they are of a bright colour, and the cuticle over them desquamates, giving to the spot a scaly appearance. The eruption is usually most copious upon the forehead, back of the neck, trunk, and groin.

In syphilitic psoriasis the spots, instead of being circular and large, are small, irregular, and less elevated. The appearance caused by this eruption varies in different parts of the body; for example—when parts are affected which are naturally in contact, as when it is between the nates or under the arms, the skin instead of presenting a scaly appearance, becomes elevated and moist, is destitute of scales, and is covered with a whitish secretion; when it attacks the palms of the hands, or the soles of the feet, instead of forming scales, the whole cuticle is thrown off, and is followed by the formation of another cuticle, which is thrown off in the same manner. The affection of the throat which accompanies the scaly eruption, is peculiar; the tonsils are the parts usually affected, and, to use the language of Hunter, there is “a fair loss of substance, part being dug out, as it were, from the body of the tonsil with undermined edges. This is commonly very foul, having thick white matter adhering to it, like a slough which cannot be washed away.”

With regard to the treatment of the scaly eruption, most surgeons of great experience agree that mercury is the most valuable remedy, when judiciously given, in moderate doses, and only to such an extent as will not produce derangement of the general health, or excite much, if any, salivation. The rule I have observed in the employment of this medicine is, to discontinue its use as soon as the eruption disappears, or the gums become in the slightest degree affected. The effects of mercury in the scaly and papular eruptions are very different indeed: and hence arises the importance already mentioned of not mistaking for the former the desquamating stage of the latter. It is always necessary, however, to remember that mercury in this as well as in other states, must be administered with judgment and discretion. If there be much accompanying pain, or an irritable state of constitution, or much de-

derangement of the general health, the employment of mercury will not only not be useful, but will prove positively injurious. The proper treatment for such states should, in the first instance, be instituted, and when the symptoms unfavourable to the use of mercury have been removed, it may then be tried, and its employment will be attended in many instances with the happiest results.

IV. TUBERCULAR ERUPTION.

This form of eruption is usually preceded by languor, debility, severe nocturnal pains, and derangement of the general health. Tubercles, but little raised above the surrounding surface, make their appearance; they are very painful and irritable; the skin becomes red, and after its ulceration a crust forms, the removal of which exposes a foul and very irritable ulcer, with inflamed irregular edges, and with no disposition to take on a healthy action. In many instances these ulcers after some time exhibit a peculiar appearance, in consequence of a healing process taking place in the centre, while the ulcer extends at its circumference by phagedænic edges. The joints, and especially the knees and ankles, are often exceedingly painful, the pain increasing at night, and in many cases they are actually inflamed. The affection of the mucous membrane, which accompanies this eruption, is of a most formidable character. Beginning generally on the pharynx or velum palati, where an aphthous sore presents itself, it rapidly spreads along the mucous membrane of the throat and nose, and is extremely apt to give rise to destruction of the hard and soft palate, as well as to extensive caries, and destruction of the spongy, ethmoid, and other bones, with the usual train of distressing consequences resulting from that destruction. This eruption is, even under the most favourable circumstances, of a formidable character; but when it takes place in individuals of a scrofulous diathesis, and when the system has been rendered irritable by intemperance or by the injudicious use of mercury, its consequences are usually painful in the extreme.

The treatment of this form of syphilis is often very unsatisfactory; and the employment of mercury in any of the various forms in which it is administered, is almost invariably found to be most prejudicial in the exceedingly weak and irritable state of constitution which attends the tubercular eruption. In the febrile state which often precedes, as well as accompanies, this affection, the diet should be unstimulating; the state of the stomach and bowels should be particularly attended to, and a healthy performance of their functions promoted by the exhibition of such remedies as in the particular circumstances of the case seem most calculated to correct derangement. When pain is very considerable, opiates are indispensable; and in order to obtain relief, to secure rest, and to allay the irritability of the system, they should be used cautiously and sparingly; the state of the skin, however, must be attended to; and in some cases mild antimonials and the occasional employment of the warm bath are useful. When the febrile symptoms subside, the diet should be generous, but light and digestible; and all available and judicious means should be employed for improving the general health. When the state of the digestive system is improved and the febrile symp-

toms have subsided, the greatest possible benefit is often found to accrue from the employment of a course of sarsaparilla and the iodide of potassium. The best local applications for the ulcers on the surface of the body are, in the first instance, poultices, with the occasional application of the nitrate of silver, or the nitrate of mercury, or the weak nitric acid lotion, and afterwards simple water dressings; and for the affection of the throat the best are, the application of the nitrate of silver in substance, or the occasional application of a liniment of the proto-ioduret of mercury, of the strength of twenty grains to half an ounce of honey, or the fluid nitrate of mercury considerably diluted.

The Tertiary Affections, consisting of certain tubercular formations, having many of the characters of rupia prominens, and often degenerating into foul and irritable ulcers; affections of the periosteum; of the bones, often ending in ulceration, or caries, or necrosis, or nodes, or enostosis, a most formidable affection of the mucous membrane of the throat and nostrils, giving rise to very distressing results, and iritis, seldom occur until a long period after the cessation of the primary symptoms, and rarely until after the secondary symptoms have either disappeared entirely or ceased for a very considerable time. The treatment of these affections must be conducted according to the general principles formerly laid down.

Having now detailed the primary and consecutive forms of syphilis, we shall conclude this subject with some remarks on the following points; namely, on the effects of inoculation with matter taken from the primary, secondary, and tertiary forms of the disease; and on the use of mercury in the treatment of syphilis.

The results of inoculation have been carefully attended to by many observers, and by none more exactly than by M. Ricord of Paris. The results of his experiments are, that the pus of primary syphilitic sores in their ulcerative and progressive stages produces the characteristic pustule, whilst that of secondary and tertiary syphilis produces nothing, any more than that of chancres in the period of reparation. In other words, primary syphilis is communicable by inoculation, but secondary and tertiary are *not*. The results of M. Ricord's experiments are confirmed by those of Dr. Mairion, who made experiments in not fewer than two hundred and fifty-seven patients in the Military Hospital at Louvain; and not only in the results of inoculation, but also as to their being communicable from one person to another, the primary, secondary, and tertiary forms of syphilis, present remarkable differences. Primary syphilis is communicable by inoculation and by contagion; the latter in the intercourse of the sexes, being the most common means of propagating the disease—the thin condition of the epidermis, the moisture and friction all rendering absorption easy. Some cases are recorded in which the disease was communicated to the fingers of medical men by inoculation, while making the necessary examinations per vaginam in labours. Secondary syphilis, although not communicable by inoculation, is by inheritance; and also, beyond all doubt, from mother to child, from husband to wife, and from nurse to child, the virus being communicated through the medium of tainted secretion. The mouth of the infant, for instance, infects the nurse, or the breast of the nurse the mouth of the

infant; and in such cases there is often considerable difficulty in determining whether the disease has passed from nurse to child, or from child to nurse. On this subject M. Ricord remarks, "The organs of the mouth are often the propagators of the contagion by a lascivious kiss, by the application of the lips or tongue to some part of the mucous membrane, by suction of the breasts, and especially in suckling. If the mouth of an infant can infect a nurse, the breast of a nurse can infect a child. These *alternative* affections are only too frequent;—hence arises a question: Is there any means of determining whether the disease has passed from the nurse to the child, or from the child to the nurse? If the disease exist in both individuals at the same time, and has arrived at the stage of consecutive disease, one can only form a probable opinion from the state of health of the father and mother, the child, and husband of the nurse, and from the time at which the disease showed itself in one or other of them, which it is sometimes very difficult to ascertain. But one may be certain that the child has communicated the disease to the nurse if it has ulcers in the fossæ nasales, tubercular pustules in a scaly or ulcerated state in any part of the body, with marks of a disease already of long standing. On the other hand, we may be certain that the nurse has infected the child, if she has ulcers at the anus, pustules on the body, or exostoses, and the child simply ulcerations of the mouth, nose, or anus."

On the use of Mercury.—The indiscriminate use, and the indiscriminate withholding of mercury in the treatment of syphilis, are both practices which are now generally allowed to be extremely injudicious; and which, fortunately for mankind, are in a great measure abandoned. That much mischief has been done by the profuse and indiscriminate exhibition of mercury; that primary, secondary, and tertiary symptoms have often been aggravated, and frightful mutilations often been induced by the improper and excessive use of this medicine, and that such severities and mutilations are much less common since a milder and more prudent practice has prevailed, are propositions regarding the truth of which there is no reasonable ground of doubt. But the opinion maintained by some writers who are unfavourable to the use of mercury, that to this medicine, and not to syphilis, are to be ascribed many affections of the skin, nose, throat, iris, periosteum, and bones—in short, the conditions which are usually regarded as the secondary and tertiary forms of syphilis, is clearly incorrect, inasmuch as these affections may occur, and often have occurred, in syphilitic patients, who have not taken any mercury; whereas in no instances where mercury is given in other diseases, do we find it produce eruptions and other affections like those of syphilis; in no instances do we find it produce iritis, disease of the nose, or of the bones. In short, these affections may be produced by syphilis without mercury, but they do not result from mercury without syphilis.

Ever since syphilis broke out in this country, mercury has more than any other medicine obtained the general confidence of the profession, notwithstanding much random and injudicious practice in its exhibition, from a notion which at one time prevailed, that it is not only a specific for syphilis, but that the disease could not be cured without it; and notwithstanding, also, the many substitutes for it which have been at various

times proposed, such as sarsaparilla, guaiacum, nitric, nitro-muriatic acids, and other medicines. Mr. Rose, while surgeon to one of the Regiments of Guards, instituted the treatment of syphilis without mercury, in the numerous cases which came under his care in the Regimental Hospital: and he there found that the primary sores got well without mercury, and that the secondary symptoms generally exhibited nearly the same characters as usual, and were, as well as the primary symptoms, removed without mercury in every instance, a few cases of iritis excepted; and from these results Mr. Rose concluded, that syphilis is curable without mercury. Many army surgeons adopted the same views, followed the same practice, and found the same results. The strong constitutions of the soldiers, the strict regulation of their diet, and freedom from exposure to cold and damp while under treatment, were all favourable for enabling them to throw off the poison of syphilis, and are supposed by some surgeons to furnish an explanation of the successful results of this treatment in the cases mentioned. Mr. Rose found that the same treatment was not successful in private practice, and in consequence he returned at length to the usual mode of treatment, and prescribed mercury. The opinion, therefore, which experience seems to justify is, that as yet we are not acquainted with any remedy of the same efficacy as mercury for extirpating the poison of syphilis. It is not, however, as has been already stated, to be used in every case, but with due discrimination; and whenever it is prescribed, it ought to be with moderation, and on no account be employed further than slightly to affect the gums.

In cases of primary sores, if the ectrotic treatment has been successfully employed, there is no poison in the system to extinguish, and therefore mercury is not given. When the ectrotic treatment has not been tried, or not been successful, mercury is given in the first three forms of primary sore, *but especially in the third*. Some limit its use to the third and to obstinate cases of the second, not allowing it at all in the first, in which it certainly does not seem so essential. For my own part, I have only prescribed mercury for those cases of the first variety of primary sore which proved obstinate after the use of other remedies. In the phagedænic sore, the use of mercury would aggravate the symptoms, and it ought therefore not to be prescribed. In some cases of secondary and tertiary symptoms it is both advisable and necessary; in cases of papular eruption, as has been already stated, it is almost always injurious, except as a mild alterative after the subsidence of the eruption. In the pustular eruption it may be given, if the treatment previously recommended has not had the desired effect, and the disease persists or returns; in the scaly eruption, and especially after the Hunterian chancre, it is indispensable, and of the greatest advantage; in tertiary affections of the skin, which have not yielded to other treatment, in periostitic affections of tertiary occurrence, and in all cases of iritis it ought to be prescribed. These are the principal cases in which mercury is essential. The conditions in which its use is undesirable are, an inflamed phagedænic, or sloughing condition of sores, whether primary or consecutive; febrile excitement; the syphilitic affections succeeding on the phagedænic form of primary sore; the strongly-marked scrofulous diathesis; and a weak and irritable condition of constitution.

CHAPTER XVIII.

AMPUTATIONS AND RESECTIONS.

IN his admirable work on Practical Surgery, the lamented Mr. Liston remarks, "The operation of amputation is not so frequently had recourse to now as heretofore, and the progress of surgical information will probably render it even more rare than at present." In the interesting Biographical Sketch of Sir Benjamin Brodie, given in the *Lancet* of May 4, 1850, the writer remarks, "The result of the progress of modern surgery has been to make the knife more daring than ever upon real occasions, but to keep it inactive, unless upon ample cause for its exercise. Never were human limbs held in greater respect and treated more conservatively than at present. We owe much of this state of things to Sir Benjamin's efforts in diagnosis and pathology." Notwithstanding this exceedingly gratifying result of progress in diagnosis and pathology, there are still many cases where it is necessary to sacrifice a limb in the hope of preserving life.

The principal conditions which present this necessity are diseases of joints or bones, for which the operation of resection is unsuitable, and when the continuance of the disease must inevitably shorten life; cases in which a limb is so severely injured that the surgeon is firmly convinced its preservation is impossible; cases of chronic gangrene, after the formation of a line of demarcation; and cases of spreading gangrene produced by an external cause, such as a gunshot wound, or compound fracture, or other injury, when there is a sound part in which the operation can be performed. However unpromising an operation may be in the last-mentioned circumstances, it affords the only chance of saving the patient's life. Such are the principal conditions which present an urgent necessity for resorting to amputation, and render its performance an unavoidable duty, for, as Dionis says, "it is better for the patient to live with three members than to die with four." There is also a class of cases in which amputation, though not absolutely necessary, may be said to be justifiable, namely, when a limb has from stiffness and an awkward position become not only useless, but extremely inconvenient. In such circumstances, when a patient expresses a strong desire to have the limb removed, the surgeon is justified in yielding to his solicitation; and the proceeding is then called an operation of "compliance."

Two of the greatest improvements we read of in the history of amputation are, the application of the tourniquet for the *temporary*, and the

employment of the ligature for the *permanent* suppression of hemorrhage. The tourniquet was invented by Morel in 1674, and improved by Petit in 1718. Its application for arresting hemorrhage during the operation diminished the danger of amputation, which accordingly became more frequent after its adoption. Useful, however, though it is, and deserving to be employed when there is a scarcity of trustworthy assistants, a more advantageous mode of arresting hemorrhage is now preferred, namely, compression of the artery leading to the part by the fingers or thumbs of an assistant. One great advantage of this method over that by the tourniquet is, that while it arrests the great flow of blood into the limb by the main trunk, it does not prevent the return by the veins of that which finds its way by collateral smaller channels, and hence there is not that excessive congestion of the limb, or that gush of venous blood which follows the introduction of the knife when the tourniquet is employed. It is almost unnecessary to remark, that in many instances it is of the very greatest importance to lose as little blood of any kind as possible; and of this I am firmly convinced, that when the charge of the main artery is committed to an intelligent and trustworthy assistant, as a general rule, there will be less loss of blood than when the tourniquet is employed. The pressure should not be applied until the knife is just about to be introduced.

A still more important event in the history of surgery is the employment of ligature by Ambrose Paré, in 1582, for permanently arresting hemorrhage. To this truly great man, the first surgeon in Europe of the age in which he lived, a man of whom France may well be proud, belongs the merit of introducing the ligature as a surgical means of permanently arresting hemorrhage; an improvement, second to none in the history of surgery, for of all hemostatics it is unquestionably the safest and best. Paré says, "For the good of mankind and the improvement and honour of surgery, I was inspired by God with this good thought." It has been remarked that, "as it was the highest of all his improvements, it was the one for which his enemies envied him the most." Previous to his time some of the many means used for suppressing hemorrhage were plunging the stump into boiling oil and pitch, the actual cautery, the vitriol button, and the use of a red hot knife in the amputation; and it surely is one of the most disgraceful facts in the history of surgery, that the physicians and surgeons of those days

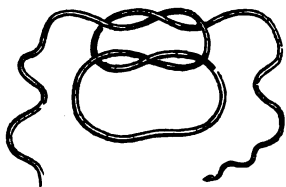
Fig. 220.



and their successors for some time, instead of honouring the man, adopting his invention, and thus promoting the improvement of their profession and the welfare of mankind, contemned his invention and contended more violently than ever for the actual cautery. Fortunately for those

who have to suffer amputation, the invention of Paré did at last prevail, and he has long been regarded not only as

Fig. 221.



one of the great ornaments of surgery, but as one whose labours have proved invaluable to mankind.—The best material for ligatures is strong, firm, silk thread. Of the two instruments for seizing the open mouth of an artery, namely, the tenaculum, and the spring artery forceps, the latter, represented above, is the preferable; and for tying the ligature the best knot is that called the reef-knot, which will be better understood from the accompanying representation than from any description that can be given of it. Deligation should be effected carefully and firmly, and one end of the ligature should then be cut off.

In all amputations of importance one assistant is required to command the artery, another to administer chloroform, to watch its effects, and attend to the patient generally,—a third to take charge of the flaps, and to tie the arteries as they are seized by the operator, and a fourth to hold the limb, and after its removal to hold the stump. Another assistant may be employed to hand instruments, sponges, ligatures, water, &c.; but it is better to have all these things conveniently placed, so that the surgeon may easily lay his hand on whatever he may require: Amputation can easily be effected with fewer assistants, but in a public hospital, or where they can be conveniently obtained, the proceeding may be conducted satisfactorily and speedily with the number mentioned above.

AMPUTATIONS OF THE UPPER EXTREMITY.

AMPUTATION OF A PART OR THE WHOLE OF A FINGER.

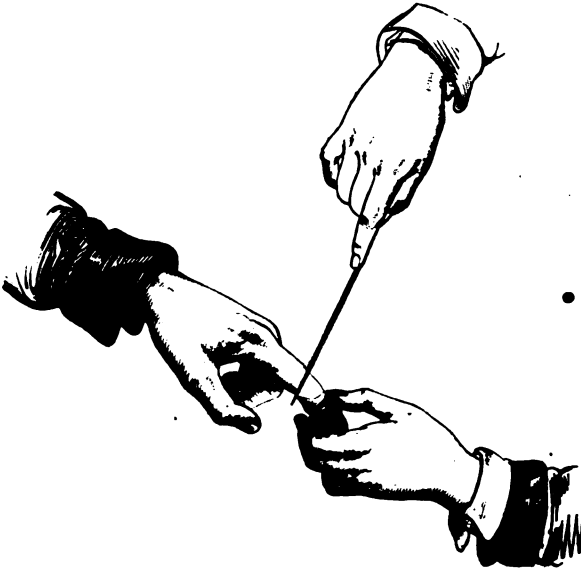
This may be accomplished either at one of the phalangeal articulations, or through one of the phalanges; the former operation is called by some, amputation in the contiguity, the latter, amputation in the continuity of the phalanges.

Amputation at any of the phalangeal articulations may be effected by any of the following modes, and the most convenient instrument for the operation is a narrow, long, straight bistoury, such as that represented below.

First proceeding.—A piece of bandage or surgeon's lint having been applied around the part to be removed, so as to afford a more secure hold for the surgeon while making the necessary movements for facilitating the progress of the knife, place the hand in the prone position, take hold of the part to be removed, bend it slightly, apply the long, narrow, straight bistoury to the radial border of the joint, carry it across the joint, to the inner side so as to make a lunated incision of the skin, then run the knife rapidly from point to heel across and into the joint, extend the finger when the knife is through the joint, and carry the knife forward parallel to the bone, and in close contact with it, bringing it out so as to finish with a semilunar flap, which must be sufficiently long to

cover the extremity of the bone and to unite with the lunated extremity of the skin on the posterior aspect.

Fig. 222.



Second proceeding.—Place the hand in the prone position with the finger straight, apply the knife to the radial border, run it across in a lunated direction on the posterior aspect to the inner side, and then without raising the knife transfix below the joint, introducing the knife at the inner, and bringing it out at the outer extremity of the incision,

Fig. 223.



and complete this first incision by making a flap in front sufficiently long to cover the extremity of the bone: then apply the knife to the upper part, and with one stroke effect disarticulation.

By this mode amputation can be performed very rapidly and elegantly, the knife being applied only twice to the finger, the first movement dividing the integument on the posterior, or, as the finger is placed in the operation, the superior aspect, transfixing, and making the long flap on the anterior, or inferior aspect; and the second movement effecting disarticulation.

Third proceeding.—Place the hand in the supine position, extend the finger, transfix on the palmar aspect of the joint, carry the bistoury at first parallel to the bone, then bring it out so as to form a flap semicircular at the extremity, and sufficiently long to cover the bone, and unite

Fig. 224.



with the skin on the dorsal aspect, then apply the knife to the front of the joint, carry it through the articulation, and divide the soft parts on the dorsal aspect without forming a flap, by bringing the knife to the surface.

This is also a very nice mode of performing this operation.

By any one of these methods this amputation may be effected by a person of ordinary dexterity in an amazingly short time; for my own part, I usually give the preference to one or other of the two last mentioned.

AMPUTATION THROUGH ANY OF THE PHALANGES.

These operations are exceedingly simple, and easily performed. The following is the usual mode. Place the hand in the prone position with the finger perfectly straight; transfix with the long, narrow, straight bistoury at the part where the bone is to be divided, and make a long flap on the palmar aspect; complete the division of the soft parts by a lunated incision across the dorsal aspect, making a short flap; and finish the amputation by dividing the bone with the bone forceps. Two arteries may require to be tied in these operations; the soft parts should be brought into the proper position, and retained by means of a single stitch; a piece of lint dipped in water should be applied, and afterwards the part should be dressed in accordance with common principles.

REMOVAL OF THE ENTIRE FINGER.

Without being at the time aware that Mr. Fergusson resorted to the same proceeding in cases where the entire finger required to be removed, I many years ago preferred removing along with it the extremity of the

metacarpal bone to performing disarticulation at the metacarpo-phalangeal articulation. The execution of either operation is as easy as could be desired, but the former has the advantage of producing less deformity,

Fig. 225.



Fig. 226.



as the adjoining fingers can be made to approach each other when the extremity of the metacarpal bone is removed, and it is surprising how little of an unpleasant appearance the hand presents in many instances after this operation. The best mode of proceeding is, to place the hand in the prone position, to direct an assistant to separate the fingers from the one to be removed, and then to make an incision along the posterior aspect of the metacarpal bone, beginning a little above the place where the bone is to be cut through, and terminating in two incisions, one extending along each side of the finger, and meeting each other a little in front of the palmar aspect of the joint. The soft parts should next be separated from the bone, the bone cut through with the bone forceps, and the finger and part of the metacarpal bone removed. After tying the arteries, the edges should be brought together by a stitch or two, and the fingers approximated. After the healing of the part, the only mark left will be a single straight cicatrix along the site of the operation, the soft parts being left perfectly entire on the palmar aspect of the hand. This is a very satisfactory, and, as it appears to me, the best mode of performing this operation. Care must be taken in the after treatment to keep the fingers nearly parallel, and not allow them to plait over each other.

AMPUTATION OF THE THUMB.

The phalanges of the thumb are amputated in the same way as those of the fingers. When both phalanges require to be removed, the metacarpal

bone should be left entire. The operation may be very speedily effected in the following manner. Commence

Fig. 227.



an incision on the radial side of the carpus about half an inch higher than the articulation of the metacarpal bone with the os trapezium; direct it at first down along the line of the metacarpal bone, and afterwards along its external aspect to the fold of integument between the thumb and forefinger, introduce the point of the knife at this under extremity, carry it up on the palmar aspect of the bone, make it emerge at the commencement of the incision, and make the flap by cutting outwards. With one or two further touches of the knife the thumb may be detached, and after this operation there remains only a single line of cicatrix on the radial border of the hand. When only the metacarpal bone of the thumb is dis-

eased, and the phalanges are entire, Mr. Fergusson has recommended that the latter should be left and the former only removed. This operation is very easily accomplished by making an incision along the radial border of the bone, and effecting disarticulation first from the phalanx, and afterwards from the os trapezium. I have performed it only once, having met with but one instance in which I considered it applicable; and I have no hesitation in saying that the phalanges were more useful than any mechanical contrivance would have been. In various instances I have removed the whole of the metacarpal bone of a finger, except the extremity, which articulates with the proximal phalanx, and have been much gratified with the results of these operations. The first time I performed this operation was in the case of a young gentleman, a member of a highly respectable family in this country. The metacarpal bone of the middle finger was diseased, but the ball of the bone did not seem to be involved, and I therefore determined to endeavour to save the finger. The operation was commenced by making an incision along the dorsal aspect of the bone, exposing it distinctly to view, and then with the bone forceps cutting across the bone in a slanting direction just behind its ball, and in such a way as to leave the attachment of the transverse ligament entire; it was then disarticulated from the carpus; the soft parts in the part of the hand were not interfered with, and the wound healed up leaving only a single cicatrix on the back of the hand. The finger is not at all shorter than it ought to be, because the ball which supports the first phalanx is kept in its proper position. The gentleman is now an officer in the army, and exerts as much force with his hand as if an operation had never been performed upon it. I have since performed the same operation in

Fig. 227. From Liston.

several instances with the same gratifying result, and can confidently recommend it for adoption in cases where it is suitable.

AMPUTATION OF THE FOREARM.

The preferable situation is the middle of the forearm. No particular advantage results from having the stump very long, and besides, the tendons in the under third are less convenient structures in the flaps than the fleshy parts higher up; on the other hand, a very short stump is less serviceable than one somewhat longer for the application of an artificial hand.

The humeral artery should be commanded by an assistant, the hand placed in a state of pronation, and the muscles put into a uniform state of extension by an assistant holding and extending the under part of the forearm.

I generally give the preference to Mr. Liston's mode of performing this amputation, which consists in making the posterior flap first, and by cutting from the skin to the bone—a proceeding which has the advantage of enabling the surgeon to make the two horns of the semilunar flap extend sufficiently towards the radial and ulnar borders of the forearm to make it easy, after introducing the knife at one corner of this flap to transfix in front of the bones, and bring out the knife at the other corner. The front flap is made by cutting towards the surface. The most elegant way of making the two flaps is to place the edge of the knife

Fig. 228.



against the skin on the posterior aspect; to run it up to the bone making a sufficient flap, and with a movement of the knife to extend the incision towards the anterior aspect at the radial and ulnar borders, and then without raising the knife to introduce it at one edge of the wound, transfix, making the knife emerge at the other edge, and by cutting towards the skin make the anterior flap. Both flaps are thus made without

Fig. 228. From Liston.

once raising the knife from the forearm. The knife is then sent round and between the bones, and a clearance having been made for the saw, the two bones may be sawn at once without altering the position of the hand.

Another mode equally easy is to place the hand midway between pronation and supination, to take hold of the soft parts on the back of the forearm between the forefinger and thumb of the left hand, to draw them away from the bones, and then to transfix with the view of forming the posterior flap by cutting outwards; but in transfixing, it is necessary to be careful to introduce the knife and to make it emerge as far towards the anterior aspect of the forearm as the bones will permit. The posterior flap is then made by cutting from within outwards. The knife is then introduced at one edge of the wound, sent in front of the bones, made to emerge at the other edge of the wound, and the anterior flap is formed by cutting from the bone towards the skin. The flaps should then be kept back, a clearance made for the saw by sending the knife round and between the bones, and the amputation completed by sawing the bones. In the one mode, the posterior flap is made by cutting from without inwards, in the other, from within outwards.

AMPUTATION OF THE ARM.

Chloroform having been administered, the arm removed from the side, and the humeral artery compressed by an assistant, the surgeon, placing himself so as to be able with his left hand to grasp the bone while it is being sawn through, forms a neat round flap in front, and in doing so directs the knife so as to leave the humeral artery in the posterior flap;—an assistant raises up the flap, but at this stage it ought not to be re-

Fig. 229.



tracted, as that would increase the difficulty of the next step, which is, to send the knife speedily behind the bone, and make a posterior flap of the same length and form as the anterior. In making these flaps, instead of carrying the knife parallel to the bone so far, and then cutting abruptly outwards, it is better to direct the knife towards the surface, so

as to give a nice rounded form to the surface of each flap. Both flaps should then be powerfully retracted, the knife made to revolve round the bone so as to clear a space for the saw, and the bone sawn through

Fig. 280.



close to the soft parts, the surgeon meanwhile holding it in his left hand; the artery should be secured, and the edges brought together by means of a few stitches.

AMPUTATION AT THE SHOULDER JOINT.

It would answer no useful purpose to describe the numerous different proceedings which have been adopted in the performance of this operation. It may be very speedily and easily effected in the following manner:—The patient should be placed on a table, with the shoulders raised, that on which the operation is to be performed projecting beyond the edge of the table. One assistant is required to administer chloroform and watch its effects; another, to compress the subclavian artery where it passes over the first rib; and when the patient is under the influence of chloroform, it is easy to command the artery completely, chiefly, I believe, because the patient, not being conscious of any uneasiness, makes no efforts to move the body, and so the pressure is not diverted from the proper part; a third assistant is ready to raise up the upper flap, and to follow the back of the knife so as to compress the second flap when the vessels are divided in completing it; and a fourth to hold the arm, and when the arm is removed to tie the arteries as they are taken up by the surgeon. In operating on the left side, the surgeon should introduce the knife at the posterior border of the axilla, send it in front of the bone, and make it emerge at the anterior border of the deltoid, about an inch below the point of the acromion process, and by cutting from the bone towards the skin, a large flap is made, chiefly of the deltoid muscle and integument; this flap is raised up by an assistant

and until it is completed, the arm should be kept away from the side, but then brought in front of the chest so as to give prominence to the head of the bone and the capsular ligament. The knife is next brought

Fig. 231.



against the joint, carried through it to the inner side of the bone, as here represented, brought down so far by the side of the bone, and

Fig. 232.



then made to emerge, completing the flap. The back of the knife should be followed by the hand of an assistant ready to grasp the flap containing the principal artery as soon as the surgeon is about to complete the flap. When the knife is fairly in to the joint, the arm should be removed from the side, to give freedom to the knife in making the under flap. In operating on the right side, the only difference is, that it will be found more convenient, in making the upper flap, to introduce the knife at the anterior border of the deltoid, about an inch below the

acromion process, and make it emerge at the posterior border of the axilla: in other words, the direction of the knife in making the upper flap, when the operation is on the right side, is exactly the reverse of its direction when the operation is on the left; in the former case it is made to penetrate at the anterior border of the deltoid, and to emerge at the posterior border of the axilla; in the latter it enters at the posterior border of the axilla, and is brought out at the anterior border of the deltoid.

The axillary artery and other vessels having been tied, the edges of the flaps are brought together by a few stitches, and the wound dressed in accordance with common principles.

Another method of amputating at the shoulder joint is, to take hold of the deltoid and move it upwards from the bone, to place the edge of the knife against the skin at the under extremity of the upper flap, to make that flap by cutting from without inwards, then to direct the knife against the joint, enter the joint, carry the knife by the inner side, and complete the under flap by cutting from the bone to the surface. In this method the knife is never raised from the body of the patient from the time it touches the skin until the under flap is completed. I have not tried this method in the living body, but have often performed the amputation in eight or ten seconds by this method, in the dead subject.

AMPUTATIONS OF THE UNDER EXTREMITY.

AMPUTATION OF THE TOES.

For the amputations of the toes, except the great toe, at any of their joints, the proceedings are the same as for the amputations of the fingers, except that when the whole of the phalanges of a toe require to be removed, the extremity of the metatarsal bone should be allowed to remain, as it is undesirable to diminish unnecessarily the breadth of the foot. Amputation of the great toe is frequently required for disease of its metatarsal bone, and it may be very easily and quickly performed by either of the following methods:

First Method. — Commence the first incision at the upper part of the proximal extremity of the metatarsal bone and on its tibial aspect, carry

Fig. 233.



Fig. 233. After Liston.

it forward to the distal extremity, direct it along the inner side of the joint to the plantar aspect of the foot, and extend it backwards to the part opposite to its commencement. This flap having been directed back, send the knife between the bones and cut outwards through the commissure between the first and second toes. By a touch or two of the knife the metacarpal bone may then be separated from the internal cuneiform. The operation is exceedingly simple by this method, and the result generally very satisfactory.

Second Method.—Commence the incision about half an inch behind the proximal extremity of the metatarsal bone, and continue it forwards to about the middle of the bone, and then make it divide into two, meeting each other on the plantar aspect of the digital commissure. Detach the soft parts from the bone, and then disarticulate from the internal cuneiform. This is an excellent mode of performing the operation, and I generally give it the preference. It leaves only a single line of cicatrix along the inner part of the foot. The same operation answers when it is unnecessary to remove the whole of the metatarsal bone, the only modifications being that it is not requisite to carry the incision so far back, and the bone has to be cut by the bone forceps,—in doing which it is advisable to cut in a slanting instead of a transverse direction, as the alteration of the outline of the foot on its inner side is thus rendered less abrupt, and the part consequently less exposed to be irritated by pressure.

AMPUTATION OF THE FOOT.

Hey's Operation.—This consists in performing amputation between the tarsal and metatarsal bones; and of the many methods adopted for its performance, I think the following the preferable. The leg having



Fig. 234.

been firmly placed on a table, beyond the edge of which the foot projects, and being secured in its position by an assistant, the surgeon takes hold of the fore part of the foot with the left hand, and having made sure of the extremities of the metatarsal bones of the great and little toes, if the operation be on the right foot, he inserts the knife on the edge of the foot a little behind the prominence of the metatarsal bone of the little toe, carries it directly forward on the edge of the foot for nearly an inch, directs it in a semilunar manner on the dorsum of the foot to the base of the metatarsal bone of the great toe, and then carries it back for

nearly an inch on the inner edge of the foot. The parts should be cut through boldly down to the bone, and the short flap brought back, and the

situation of the tarso-metatarsal articulations exposed. The knife is next introduced at the extremity of the incision on the inner edge of the foot, sent underneath the bones, and made to emerge at the outer edge of the foot at the commencement of the first incision, and a long flap is made from the sole of the foot, sufficiently long to cover the ends of the bones and to unite with the short flap on the upper part of the foot. The surgeon then presses heavily on the forepart of the foot, so as to make it more easy to send the point of the knife into the articulations between the bones; and this having been done, the operation is speedily completed. The long flap covers the extremities of the bones, and a single cicatrix along the upper part of the stump is the only permanent mark of the operation.

This is generally a very satisfactory operation in cases for which it is suitable. The only differences to be observed when the operation is on the left foot are, 1st, that it is more convenient in making the first incision to commence behind the base of the metatarsal bone of the great toe, and to make it terminate behind that of the little toe; and, 2d, that in transfixing to make the long flap below, it is more convenient to insert the knife at the outer, and to make it emerge at the inner edge of the foot.

In performing this operation an elegant proceeding is, after making the upper flap, to transfix without raising the knife from the foot, so that the upper and under flaps are made by one continued movement of the knife.

Chopart's Operation.—This operation, improved by modern surgeons, retains the name of Chopart, who first performed it. It consists in performing amputation at the medio-tarsal articulation, or, in other words, at the articulation formed by the astragalus and calcaneum behind, and the scaphoid and cuboid bones in front, the astragalus and calcaneum

Fig. 285.



being the only two bones that are left. The site of the articulation is first sought for, and the best guides for finding it are the projection of the scaphoid bone on the inner side, immediately behind which is the articulation, and the projection of the base of the fifth metatarsal bone on the outer edge of the foot, about half an inch behind which projection, and about midway between it and the anterior part of the malleolus

externus is the outer part of the articulation. These guides having been found, a short flap is formed above and a long one below, and the proceeding is in all respects similar to that in Hey's operation, except that the incisions are commenced further back, namely, about half an inch behind the guides already mentioned on the margins of the foot.

Relative Merits of the two last-described Operations.—In Hey's operation, the anterior lever of the foot remains longer than the posterior; and the tendons of the extensor muscles contract adhesions to the upper part of the foot, which, aided by the insertion of the tibialis anticus muscle, prevent the drawing up of the heel, and consequently there is no danger of the front of the stump being pressed against the ground. In all cases which have come under my observation, the result of this operation has been all that could be reasonably expected or desired. Perfect candour requires me to express a different opinion regarding Chopart's operation. Although both in one case in which I performed this operation some years ago, and in another in which another surgeon operated, I am aware that the attitude of the stump has remained most satisfactory, and the patients can walk with perfect ease, yet, in a third case, in which I again operated, and in which every possible care was taken to maintain a proper attitude of the stump, the preponderating action of the muscles of the calf of the leg was not counteracted by adhesions of the tendons in front to the cicatrix or other structures; and consequently, the heel was drawn up and the cicatrix made to project against the ground in attempts at walking—an untoward result too common in the experience of surgeons.

The occurrence of this circumstance where the greatest possible care, *as far as attitude was concerned, was taken to prevent it*, has given me an unfavourable opinion of this operation, and I should not hesitate, therefore, in future, after candidly explaining to a patient the probable results of it compared with amputation at the ankle-joint, to express a decided preference in favour of the latter, which is so very satisfactory in cases for which it is suitable. It is the duty of every one to give the result of his own experience, and I have therefore stated very unreservedly the conclusion at which I have arrived regarding Chopart's operation. It is true that it is exceedingly easy to be performed, much more so than that of Hey, because the articulation is much more open, and therefore much more easily entered; but this is comparatively a small matter, it being the ultimate result that demands the serious consideration of the surgeon who has to advise regarding the welfare of his patient.

AMPUTATION AT THE ANKLE-JOINT.

The following are Professor Syme's directions for the performance of this amputation.—“The foot being placed at a right angle to the leg, a line drawn from the centre of one malleolus to that of the other directly across the sole of the foot will show the proper extent of the posterior flap; the knife should be entered close up to the fibular malleolus, and carried to a point on the same level on the opposite side, which will be a little below the tibial malleolus; the anterior incisions should join the two points just mentioned at an angle of 45° to the sole of the foot, and long axis of the leg. In dissecting the posterior flap, the operator should

place the fingers of his left hand upon the heel, while the thumb rests upon the edge of the integuments, and then cut between the nail of the thumb and the tuberosity of the os calcis, so as to avoid lacerating the soft parts, which he at the same time gently, but steadily, presses back, until he exposes and divides the tendo Achillis. The foot should be disarticulated before the malleolar projections are removed, which it is always proper to do, and which may be most easily effected by passing a knife round the exposed extremities of the bones, and then sawing off a slice of the tibia connecting the two processes." In performing this

Fig. 236.



operation I have followed the above directions with the exception of those contained in the last sentence. Instead of disarticulating the foot, and then sawing off the malleolar processes and a thin slice of the tibia connecting them with each other, I have, after making a clearance for the saw by sending the knife round the bones, sawn off the malleolar processes and a very thin slice of the tibia, without effecting disarticulation. This shortens the proceeding, and whenever I have performed this operation, nothing could be more satisfactory than its results. The operation according to this method is exceedingly easy to be performed, and some of the many advantages of this amputation are, that the soft parts of the heel thus furnish an admirable cushion for a covering to the bones, that the stump is in consequence excellently adapted both for bearing the superincumbent weight, and for progressive motion—a recommendation which the method of making the flap from the heel possesses over all the other modes which have been proposed—and that the cicatrix which presents a single line, is in front of the stump, and therefore escapes the direct pressure of the superincumbent weight in walking. Patients can, in most instances, very soon bear the superincumbent weight on the stump, and with an artificial foot into which the rounded stump is introduced, they can walk easily and not very ungracefully. In bringing back the posterior flap over the calcaneum the greatest care must be taken not to use any violence by which its vitality might be endangered, and a risk induced of its sloughing after the operation.

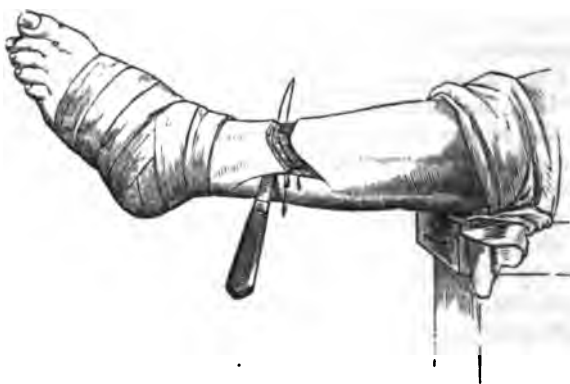
So favourable are my impressions of this operation, and of the above

mode of performing it, that I deem it unnecessary to detail the many different methods which have been proposed since the introduction of this operation into the practice of the surgeons of this country. I think it proper, however, to add, that of the cases of disease of the bones of the foot, and of the ankle joint, which have come under my own observation, both public and private, and that of some of my colleagues at the Infirmary, there have been much fewer in which this operation would have been suitable, than I at one time anticipated from the statements of others. I have been much struck with the fact that, in a great number of the cases which came under our notice, there have been, together with disease of the bones of the foot, abscesses in the under extremities of the bones of the leg. This is a point to which my attention has been particularly directed since the advantages of amputation at the ankle joint have been thoroughly appreciated; and while I think this operation an admirable one for a certain class of cases, I see no prospect of its superseding amputation in the under part of the leg.

AMPUTATION OF THE LEG.

An excellent and speedy mode of performing this operation, and that which I have usually adopted, is the following:—The circulation being commanded by pressure on the femoral artery, the surgeon being placed on the left side of the patient, applies the knife near its heel to the right side of the leg, and draws it across to the left side in a semilunar direction, so as to form a short anterior flap, and then without raising the knife transfixes the leg, the knife entering and emerging at the extremities of the first incision, and a long posterior flap being formed by cutting from the bones to the surface. The soft parts between the bones underneath may be cut before the knife is brought to the front of the leg, and then by a few touches the short flap in front is brought back, the soft parts between the bones divided, and a clearance made for the

Fig. 287.



saw. The surgeon being on the left side of the patient is able to hold the bones with his left hand during the movements of the saw. The projecting angle of the tibia should be removed by the saw or bone-forceps, that it may not irritate the integument over it.

Another and a very easy method is to form the posterior flap in the first instance; and with that view the operation is commenced by transfixing the leg. The points of transfixion are then connected together by a semicircular movement of the knife across the front of the leg, and the flaps having been turned back and the bones cleared by carrying the knife around and between them a little above the points of transfixion, the amputation is completed by sawing the bones. The accompanying illustrations will make this operation perfectly intelligible.

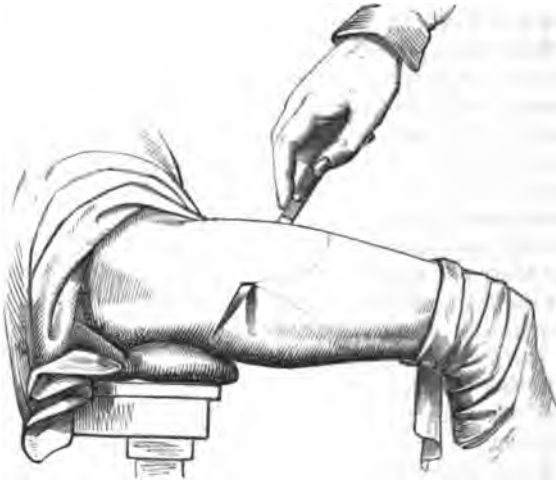
I quite concur with Professor Lawrie of Glasgow in all that he has done to produce a favourable impression of this operation, and also in what he has said as to the facility with which patients walk with an artificial limb into which the leg is fixed with the knee straight. Many of my patients walk with perfect ease with an artificial leg and foot, and without any appearance of mutilation or deformity. I have made it a point to leave the stump as long as possible, and have seen no reason to be otherwise than satisfied with the proceeding. Having been in the habit of amputating at all parts, as far down as the commencement of the inferior third of the leg, I am enabled to bear my testimony to the advantage of the proceeding. As a proof of the facility with which patients walk after this operation, I may state that a man, both of whose legs I amputated at the commencement of the inferior fourth, in the Aberdeen Royal Infirmary, on account of gangrene, walks very well on two artificial legs and feet which I gave to him after the stumps were in a fit state to be introduced into them; they were made by a surgical mechanist in Aberdeen. From my own experience, and that of my colleagues, I should be exceedingly sorry to see this operation abandoned for one that involves more mutilation of the body.

AMPUTATION OF THE THIGH.

• The patient having been properly placed, the artery compressed by a trustworthy assistant, and the leg held in the proper position by another assistant, the surgeon, if the operation be on the left thigh, stands on the fibular side of the limb, and having taken hold of the soft parts in front of the bone with his left hand, raises them a little, and performs transfixion by introducing the knife on the outer side, carrying it across in front of the bone, and making it emerge on the inner side, and then forms the anterior flap by cutting towards the surface. An assistant then simply holds up the flap without retracting it at this stage, and the surgeon sends the knife behind the bone about an inch lower than the commencement of the first incision. The advantage of observing these two directions is, that the knife is more readily sent behind the bone without touching the skin on either side. The knife is then brought to the surface in the direction represented by the dotted line in the accompanying engraving, and by this movement the posterior flap is formed. This flap should be a little longer than the anterior to compensate for the greater retraction which takes place in it, owing to its muscles having less connexion with the bone than those of the anterior flap. An assistant retracts both flaps very forcibly, and the surgeon makes the knife revolve round the bone so as to effect a clearance for the saw. He then grasps the bone in his left hand, and saws

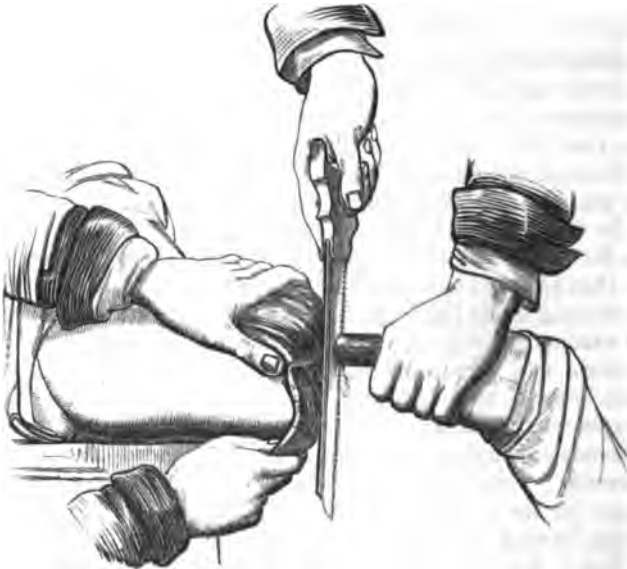
it through, close to the soft parts, moving the saw in a vertical direction. The only differences in operating on the right thigh are that the surgeon

Fig. 288.



stands on the tibial side, and introduces the knife on this, instead of the fibular aspect. If, however, in this case there be the least prospect

Fig. 289.



that his standing on the tibial side may cause an awkwardness or want of proper freedom for making the necessary movements of the knife, the

operation can be performed with perfect facility and convenience when standing on the other side; only the bone, while it is being sawn, cannot then be conveniently held by the left hand of the surgeon.

AMPUTATION OF THE HIP-JOINT.

The cases in which it is necessary to resort to this operation are not numerous; and this is fortunate, for although a sufficient number of successful cases are on record to make it perfectly justifiable on the part of the surgeon to resort to it in extreme circumstances, yet it is proved beyond doubt, that as regards ultimate consequences, it is an exceedingly perilous proceeding; though there is no difficulty in executing the operation, and it can be performed in the living body with great ease in less than twenty seconds. In the only instance in which I have performed it in the living body, and often when I have performed it in the dead body before my class, the operation has not occupied even so much time. I mention this merely to show that there is no difficulty in performing it. The following observation of Mr. Liston should be strongly kept in view:—"These operations must be undertaken with determination, and completed rapidly, in order that dangerous effusion of blood may be prevented; they are not to be attempted without great consideration, and only under very pressing circumstances." From much practice in performing this operation on the dead body, I have arrived at the conclusion that Mr. Liston's method is preferable to any other. He commenced transfixing by introducing the knife midway between the anterior superior spinous process of the ilium and the trochanter major of the femur. The following description and illustration, taken from his admirable work on Practical Surgery, will make his method perfectly intelligible:—"By forming the flaps from the anterior and posterior aspects of the limb, the bone may be exposed

Fig. 240.



and sawn at the inner trochanter, or it may be removed at the joint. In making the incision thus high, the common femoral is compressed, as it passes over the brim of the pelvis, and an assistant must follow the knife with his hand, and grasp firmly the anterior flap, whilst others

are ready to compress those of the posterior as soon as the sawing, or disarticulation, is completed. This mode of getting at the head and neck of the bone is much preferable to that usually followed, and is in every respect safer, as I have more than once ascertained from actual practice on the living body. The fore-part of the articulation is fully exposed immediately on the anterior flap being formed. The capsular ligament is cut by drawing the knife across determinedly, as if it were the intention of the operator to cut off the head of the bone. The round ligament and posterior portion of the capsular are cut, and the blade of the instrument having been passed behind the neck and trochanters, the posterior flap is quickly formed, so as to allow the limb to drop. The vessels on the posterior aspect are first tied, then the femoral and those in the anterior flap, which has been commanded by the assistant, are uncovered one by one and secured."

AMPUTATION OF THE PENIS.

The part to be removed is covered with some lint, laid hold of by the left hand, put upon the stretch, and then removed by one stroke of a long knife moved rapidly across the organ. Such vessels as require ligature having been secured, the surgeon lays hold of the mucous membrane of the urethra by means of a forceps, and divides it into four equal flaps, by four cuts with a pair of scissors, and then by four small sutures of fine thread unites each flap to the common integument. The skin and mucous membrane unite together, and the contraction of the cicatrix has the effect of keeping the urethra open and of sufficient calibre.

RESECTIONS.

Under this title are comprehended the removal of the articular extremities of bones—in other words, excision of joints—the resection of long bones to their continuity, and the partial or entire removal of certain bones. One of the earliest, if not the first operation actually performed of this kind on record, is excision of the knee-joint, by Filkin of Liverpool, in 1762. Very soon after this, Vigaroux and David removed the head of the humerus, but their operations were not published until after the upper part of the same bone had been removed by White of Manchester, in 1768, to whose operations we shall afterwards have occasion to refer. The gratifying results which, in the experience of many surgeons in this and other countries, have followed the excision of joints, have contradicted many of the objections urged against these operations; they have proved that many limbs may be preserved, and in a state to be ultimately useful, which would otherwise have been subjected to amputation; and have contributed much also to diminish the number of amputations for diseased joints of the upper extremities. To Professor Syme, too great praise cannot be awarded for his successful exertions in this department. It may be stated that the two joints on which these operations have been most successfully practised, are the shoulder and elbow joints; in the ankle it is of very doubtful advantage, and in the knee, hip, and wrist joints, the want of success has been unquestionably great,—so great indeed in the knee and hip, that the present state of

experience appears to suggest the propriety of avoiding resection in these joints, except in the case of injuries.

PARTICULAR RESECTIONS.

RESECTION OF THE SHOULDER-JOINT.

The many different methods which have been adopted for this operation may be almost all reduced to one or other of two principal methods, namely, that in which the bone to be removed is exposed by making a flap, and that in which it is exposed by means of a simple incision. Of these two methods it may be stated generally, that while the latter is sufficient when the operation is performed for the purpose of removing the crushed head of the bone, yet in most cases where it is employed for the removal of diseased bone, the former will be found the preferable proceeding. The directions for the performance of the operation by means of a flap are very simple:—make a vertical incision from the apex of the acromion along the middle of the deltoid to near its insertion, and from the under extremity of this incision make another upwards and backwards, cutting in a semilunar direction towards the posterior border of the axilla; raise up the flap, which will comprehend the external portion of the deltoid; open the joint; detach the muscles which are inserted into the tuberosities; thrust out the head of the bone, and saw it through, carefully guarding against injuring the soft parts. Such is the method practised by Professor Syme. It would answer no useful purpose to describe the different varieties as to the forms of flap recommended by many other surgeons. White of Manchester, Orred of Chester, Larrey, Sir Charles Bell, and some others exposed the bone by a single longitudinal incision extending from the upper part of the shoulder to near the insertion of the deltoid. Jaeger gives a collection of fifty-three cases of excision at the shoulder-joint, of which large number he states that only two had an unfavourable result. With the exception of the case of Edmund Pollit, operated upon by Mr. White in the Manchester Infirmary, on the 6th of April, 1768, there has uniformly been a degree of shortening proportioned to the extent of bone removed. In the case referred to, although nearly four inches of the bone were taken away, the arm was very little shortened, and the form of it little altered: the rotatory and other movements and the use of the joint became complete, and the part from whence the bone was taken soon acquired a considerable degree of firmness. These and other considerations have led some to conclude, and so far as one can judge, rightly, that this interesting case was not one of caries, but acute necrosis, in which the head of the bone was not removed by the operation, but detached from the upper part of the shaft by disease, and became united to the regenerated shaft after the removal of the part which had been affected with necrosis. In Professor Syme's valuable contributions to the Pathology and Practice of Surgery will be found some very interesting observations on this case by White, which, whatever was the real nature of the disease for which the operation was performed, has, in a great measure, "led the way to all that has been done in this department of surgery."

RESECTION OF THE ELBOW-JOINT.

Mr. Park of Liverpool published a work in 1783, in which he proposed to open the knee and elbow-joints, and to saw off the extremities of the bones entering into their formation, when in a carious state. Falkin of Liverpool had, as early as 1762, performed the operation on the knee; and the celebrated Moreau, following the suggestion of Park, was the first to perform the operation on the elbow-joint. The mode of performing it which he devised and adopted, with a very slight modification, is upon the whole the best. Sir Philip Crampton performed this operation in February, 1823; and in 1829, Professor Syme gave, in the "Medical and Surgical Journal," an account of three cases. Since that time, most good surgeons have resorted to it in preference to amputation in cases in which it appeared suitable. In Jaeger's collection of cases of this operation it is stated that, out of thirty-four, only four had an unfavourable result. The conditions in which amputation is to be preferred to excision are, when the strength of the patient is so much diminished as to make it doubtful whether he could bear a protracted discharge, and when the disease is supposed to extend beyond the articulating extremities of the bones.

The operation may be performed in the following manner:—The patient having been placed in the prone position with the elbow semi-flexed resting on the edge of a table, and presenting its posterior aspect to the surgeon, the joint is conveniently exposed by a wound in form resembling the letter H. The parallel portions of the wound may be two inches long, and the transverse portion should extend from the very margin of the outer tuberosity of the humerus along the upper part of the olecranon process to as near the inner tuberosity as may be without endangering the ulnar nerve. For the purpose of avoiding the ulnar nerve, it has been suggested to thrust down the knife perpendicularly into the joint with its back directed towards the nerve, and then to make the transverse incision by cutting towards the external tuberosity. The two square-shaped flaps having been detached from the subjacent parts, and the bones brought into view, the olecranon process should be cut through with the bone forceps, and the lateral ligaments divided. After which the humerus can easily be made to protrude, and be sawn off through the tuberosities. The head of the radius, and the portion of the sigmoid cavity of the ulna left after the division of the olecranon process, should be removed by the bone forceps or saw, and bleeding having been arrested, the edges of the wound should be brought together, and the arm secured in a semi-flexed position. A most useful joint formed by ligamentous union is the usual result.

Resection of the wrist-joint is not found to succeed, and therefore when diseases of that articulation prove incurable, amputation is the advisable proceeding. Resection of the ankle joint in cases of disease is of doubtful propriety, it being questionable whether the best results of that operation are so useful or satisfactory to the patient as an artificial foot after amputation at the ankle joint. And with regard to resection of the knee and hip joints, so large a proportion of the cases hitherto recorded have terminated fatally, and so very few have been

attended with a favourable result, that it has now become pretty clear that they are hardly admissible into the list of justifiable operations, except in the instances of gunshot wounds, or other injuries of the bones forming these articulations. It is therefore deemed unnecessary to give the statistics of these operations, or to describe the mode of their performance.

REMOVAL OF THE UPPER JAW.

That it may be more clearly seen to whom belongs the merit of first proposing the removal of the whole of the upper jaw, the operations on this bone may be arranged into two classes, namely, those which consisted in scooping out the contents of the antrum, and more or less of the surrounding parts, and those which consisted in the entire removal of the jaw.

The first recorded operation belonging to the former of these two classes was performed by Akoluthus, a physician of Breslau, in 1698, on a female who had a tumour in her jaw; this he succeeded in removing partly by cutting, and partly by the actual cautery, performing the successive steps of the operation at intervals of some days. Various operations of this kind were performed by Desault, by Jourdain, by Dupuytren, and others. One performed by Dupuytren in 1819, brought this kind of proceeding very much into notice, and since that time it has not been unfrequent. One of the most remarkable examples on record is an operation performed by Dr. Thomas White; remarkable not less on account of the recovery of the patient than for the extent of parts removed; most of the jaw was no doubt removed in this case, partly by caustic, partly by scooping, and partly by the actual cautery.

As to the second of these two classes of operations, to Professor John Lizars of Edinburgh unquestionably belongs the merit of having first proposed the removal of the entire jaw. He made that proposal in 1826, and suggested that the carotid artery should first be tied. He attempted his first operation in December, 1827, but was obliged to abandon it without succeeding, on account of hemorrhage. The patient, who was a collier, lived seventeen months after the attempt. His second operation was performed on the 1st of August, 1829. The wound was healed on the sixteenth day and the patient left the hospital, but died suddenly three days after her dismissal. In this case the temporal and internal maxillary arteries, and the external jugular vein which had been divided were tied. His third operation was performed on the 10th of January, 1830; the external carotid was first tied; on the 5th of March the woman was able to leave the hospital.

Gensoul of Lyons, in May, 1827, performed this operation with success on a young man seventeen years of age, and he states that he was not aware of Professor John Lizars having proposed the operation; he did not adopt the proceeding of first tying the carotid artery. It appears then that Professor John Lizars was the first that proposed, and that Gensoul, without the knowledge of his proposal, was the first that performed this operation.

Of the many methods adopted in the performance of it, that of Syme appears to be the best. After the removal of one of the central incisors,

two incisions are made, one from the inner angle of the eye to the lip, and the other from the junction of the malar and maxillary bones to the angle of the mouth; and the flap is dissected up to the margin of the orbit. The nasal process is then divided by a pair of strong cutting pliers, one blade being introduced into the orbit and the other into the nose; by the same instrument it is separated from the malar bone; the palatine arch is next clipped through; the bone is then pushed down and detached, care being taken to preserve, if possible, the palatine process of the palate bone and the velum palati. It is quite unnecessary to tie the carotid artery, but pressure on it on one side should be employed, while the bone is being depressed and removed.

RESECTION OF THE LOWER JAW.

The following case of resection of the lower jaw performed by me in 1840, appeared with the accompanying illustration in the "*Edinburgh Medical and Surgical Journal*," for July, 1840.

In the end of November, 1839, Thomas Grant, aged nineteen years, applied to me under the following circumstances.

The left side of the lower jaw from near the symphysis to the angle was diseased, and so extensively enlarged as not only to produce great swelling and deformity of the face, but also by pressing inwards upon the tongue, considerably to impede its movements. The diseased portion

Fig. 241.



Fig. 242.



of bone also hung down upon the upper part of the neck, and extended considerably backwards. The soft parts of the cheek and upper region of the neck were very much inflamed, giving rise to diffuse swelling; and two abscesses had burst over the middle of the diseased portion of the bone. The pain in the bone was at times most excruciating. He informed me that the disease had commenced about three years previously,

when it was supposed to arise from the irritation caused by a carious tooth, which was at the time extracted without affording him any alleviation of his sufferings. From the nature of the case it was evident that excision of the diseased portion of bone was the only remedy; and several of my professional brethren, well qualified to judge, were decided as to the necessity of such an operation. With the assistance of Dr. Fowler, now of Corstorphine, and of my senior pupil, the operation was performed on the 15th of February, 1840, in the following manner.

I commenced my first incision at the middle of the lower lip and extended it downwards over the middle of the chin, to a little below the margin of the diseased bone. From the termination of that incision, I ran the scalpel along the entire inferior border of the bone, turning up behind the angle and ending about midway between it and the condyloid process. The extensive flap contained within those incisions was next dissected up, and laid upon the upper part of the face, so as fully to expose the diseased portion of the bone.

The jaw was then sawn through, immediately at the left side of the symphysis, and afterwards obliquely through the ascending ramus, opposite the last molar tooth, particular care being taken to protect the vessels by pressing them inwards.

The section of jaw was then carefully relieved from its internal soft attachments by drawing the knife along its internal surface, keeping its edge close upon the bone. The diseased soft parts connected with the openings of two abscesses on the cheek, and some diseased tissues in the upper region of the neck were then cut out, and after suppressing the hemorrhage, which was excessive, the flap was brought down, and by means of a few stitches and adhesive plaster the edges of the wound were kept in apposition.

About four weeks afterwards, on the 14th of March, union was entirely effected, leaving so little external deformity as to show very slight traces of such an operation.

The mode of performing resection of the lower jaw must vary according to the situation and size of the tumour, and the extent of the part to be removed.

Fig. 243.



Figs. 241, 242, 243. Drawings of case referred to in the text.

CHAPTER XIX.

DELIGATION OF ARTERIES.

THE deligation of an artery is performed in order to obliterate its canal, and stop its circulation at that point ; to arrest hemorrhage from itself, or from some of its ramifications, when wounded or otherwise laid open ; or, to divert the chief current of blood from a diseased portion of the same trunk, or of one of its branches, as in the operation for aneurism. If the object be to arrest hemorrhage, the vessel is, when possible, exposed at the seat of injury : and two ligatures are applied, one above, and the other below the point of lesion. Deligation of the main trunk on the cardiac aspect of the injury would suspend the flow of blood from the proximal orifice of a divided artery, though probably not from the distal, or from a puncture in an artery not completely cut through, owing to the free anastomosis supplying blood to the main channel at some little distance below the point at which circulation has been arrested by the ligature. This is especially the case in the arteries of the extremities, the ramifications of which form very numerous inosculations. The only safe rule of practice, therefore, is to accomplish deligation both above and below the seat of injury.

When the object is to suspend or weaken the current through an aneurism, the vessel is to be exposed, and the ligature applied at some spot on the cardiac aspect of the lesion, but not so near as to endanger the deligation of a diseased portion of the vessel, or, on the other hand, so distant from it as to permit the collateral circulation to supply blood to the aneurism, except in very much diminished quantity. The ligature must also be applied at a point where no large branch proceeds from the vessel either above or below ; so that space may be allowed for the formation of an efficient coagulum. It must be small, round, smooth, and firm, so as to effect clean division of the inner and middle coats of the artery, yet without laceration of the external tunic ; and it must be strong, so that it may be pulled tightly without breaking.

When an artery is completely divided in a wound, each extremity is to be seized by the spring forceps or tenaculum, and drawn out, isolated from the surrounding tissues, to a sufficient extent to permit the ligature to be cast round it. At the same time, care is to be taken to exclude veins and nerves, as also portions of muscular tissue, which would prevent the ligature from embracing the arterial tunics with accuracy, or from effecting the necessary division of their inner layers ; while they would, by speedy absorption or sloughing, relax the noose, endanger its slipping, and so give rise to secondary hemorrhage. The ligature is

always to be tied with precision in the form commonly called the reef-knot, which is drawn as tightly as possible, there being no danger of dividing the cellular coat of the vessel.

For tying an artery in its continuity, the instruments generally required are, two or three sharp scalpels of different sizes; a pair of good dissecting forceps; two or three flexible copper spatulæ, about an inch in breadth; and an aneurismal needle, of curve varying according to the vessel requiring operation, and provided with a small round aperture near its point, just large enough to transmit the ligature, with which it is to be armed before commencing the operation. The point of this needle must be so far blunt as to be in no danger of piercing the arterial or venous coats, yet not to such a degree as to require much force to send it through the lax cellular tissue surrounding them. There should be spare silk at hand, a few suture needles, and isinglass plaster, besides the usual accompaniments of surgical operations—sponges, lint, and water. It is proper also to have a pair of spring forceps, lest any small vessel be divided during the dissection. It is better to avoid the use of the director in the division of the layers, as this instrument always causes more or less bruising of the parts.

The patient is placed in a position suitable for deligation of the particular artery. During the first incision, the posture should be so managed as to make the skin somewhat tense in the proposed line of wound, as this facilitates the perception of the guides to the vessel, and permits a smooth division of the integuments. Subsequently, however, relaxation is advisable, in order to allow of nerves and veins being drawn aside, and to facilitate the easy passage of the needle. The guides to the artery are examined, and its course is traced by its pulsation, when this is perceptible on the surface. An incision of ample length is then made over the vessel, nearly in a line with its course, so as to obtain the full room afforded by the length of the wound; but sometimes a slight obliquity of direction is useful in facilitating the discovery of an intermuscular space, when the dissection is to be prosecuted deeply. The knife should not cut more than the integument and subcutaneous cellular tissue at this first stroke, whether the artery be deep or superficial. In the latter case, a slight excess in depth might lead to wounding the vessel; and in the former, muscular fibres might be cut, the blood from which would obscure the farther dissection. Superficial veins and nerves are avoided in this incision, when their course is seen or known. The margins of the cutaneous wound are drawn in apart, and the deep fascia divided along the yellow line marking the muscular interspace, when this is the farther course of the dissection; or it is cautiously pinched up with a dissecting forceps, and divided in the requisite direction and extent by the surgeon lateralizing the cutting edge of the knife towards himself, when the vessel is superficial.

This motion of the knife is by far the safest; and when other things permit, the operator should stand on that side of the patient, which will enable him to lateralize the knife at the same time, away from the chief vein or nerve that is most in danger of injury. By thus keeping as much as possible the flat surface of the knife directed to the artery, and its back towards the vein or nerve, any accidental slip will

be less apt to injure either. In deep dissections, the sides of the wound are kept apart by the copper retractors, bent to the required form. These take up much less room than the fingers of an assistant, and by exerting pressure assist in preventing venous oozing. Veins are avoided or drawn aside if necessary, as, when wounded, the blood which they furnish seriously obscures the most delicate part of the operation.

As the dissection deepens, a sponge or piece of lint is employed to remove any blood, which interferes with a distinct view of the parts, and nerves are gently drawn aside when in the way. The sheath of the vessels, being at last reached, is pinched up and opened in the same cautious manner as already described, to the extent of half an inch in front and over the artery rather than above the vein, which, if large, might overlap and obscure the former. Any loose cellular tissue now found covering the artery must be directed by the gentle touches of the scalpel, until the coats of the vessels are seen distinct and white, and sufficiently exposed in front, to permit the insinuation of the point of the aneurismal needle between them and surrounding objects; while all farther separation or disturbance is effected merely by the track of the needle in making its way round. The artery is by no means to be exposed to a greater extent than this, and must not be rudely lifted up in passing the armed needle. The point of this instrument should be entered on that side of the artery, on which there is the greater risk of including nerve or vein; because at first it can be applied close to the artery with greater exactness than can perhaps be maintained during the rest of its course. Being applied at the proper side, and in close contact with the vessel, the point is insinuated between it and the adjacent object, with a gentle lateral motion of the handle, and is afterwards carried round by making the free extremity of the latter describe part of a circle, of which the artery represents the centre. When the point of the needle, having completed the circuit, is felt by the finger to be partially covered with cellular substance, the latter is to be cleared off by a touch with the nail or scalpel. The point being brought into view, the loop of the ligature is then seized with the forceps, drawn through a little and detained, while the needle is gently withdrawn; after which the loop is cut, and one portion of the ligature removed. The single thread now remaining is tied as firmly as possible in the reef-knot. One end being allowed to remain, it is brought out at the most convenient part of the wound, which is to be drawn together, secured by isinglass plaster or suture, and treated for adhesion. A piece of plaster should be applied over the extremity of the ligature which hangs from the wound, so as to prevent its catching anything that might endanger its forcible withdrawal.

Throughout the whole operation, the utmost delicacy of manipulation is requisite; and peculiarly so while exposing the vessel and passing the aneurismal needle. The chief dangers to be avoided in the deligation of an artery are, its undue exposure and separation from its connexions laterally and posteriorly,—treatment which would insure sloughing of that portion, and consequent secondary hemorrhage; the wounding of veins, which accident would cause troublesome hemorrhage, and possibly

induce phlebitis, or in some veins of the neck and axilla, might cause instant death by giving entrance to air; and, lastly, the including of a vein or nerve in the ligature, a circumstance which, happening to one nerve at least, the pneumogastric, would, if not discovered and corrected, speedily prove fatal; as indeed has been known to occur. The ligature becomes loose by absorption, ulceration, or sloughing of the portion of arterial tunic within its noose, in a period varying from ten to twenty, or even thirty days. At the expiry of the third week, it may be gently touched, when, if loose, it will come away immediately; but if the slightest resistance is felt, no force must be employed. In a few days it may again be tried, as, when left to itself, it frequently remains a considerable time in the wound after its complete detachment, delaying thereby the complete healing of the wound, and protracting the period of anxiety as to its safe separation naturally experienced both by surgeon and patient.

DELIGATION OF THE COMMON CAROTID ARTERY.

[This operation was first performed for aneurism by Sir Astley Cooper, in 1805.—ED.]

The common carotid may be tied above or below where the artery is crossed in front by the omohyoid muscle.

In the first-mentioned situation, deligation of the common carotid, is termed the superior operation. It may be required for wound or aneurism of any of its branches, and may be performed in the following manner:—

The patient being placed on his back, with the chest a little raised, a small cushion under the nape of the neck, so as to make it prominent in front, and the head thrown well back, with the face thrown to the opposite side from that on which the artery is to be tied, an incision is made from the part nearly opposite the angle of the jaw, to a little below the level of the cricoid cartilage, along the inner border of the sterno-mastoid muscle, which forms the guide to the vessel, and of which the course corresponds with a line drawn from the sternal extremity of the clavicle in the direction of the mastoid process. The skin, subcutaneous, cellular, and adipose tissue, the platysma myoides, and the layer of cellular tissue beneath being successively divided, the head is then turned a little, so as to relax the parts about the wound and permit its edges to be drawn apart, any superficial veins being at the same time drawn aside. The deep fascia is now to be pinched up with a forceps, and cut in the cautious manner formerly described; which being done, the sheath of the vessels will be found in the angle formed by the sterno-mastoid and omohyoid muscles.

The descendens noni nerve, or some of its branches, will be seen in this stage, and must be carefully guarded from injury. The sheath appears of a dark colour towards its outer part, where it covers the vein, but of a lighter hue on its inner aspect, where it conceals the artery; and is occasionally pierced by a vein from the thyroid body which runs across the carotid artery about the middle of the neck to enter the internal jugular. This vein, when present, must not be cut, as it would yield

much blood, and obscure the farther progress of the dissection in its most delicate stage. The sheath is opened to the extent of half an inch towards its tracheal side—that is over the artery rather than the vein, so as to confine the latter, which being very large, slightly overlaps the

Fig. 244.



former, especially in expiration, when it becomes very turgid. The proper mode of opening it is, as before explained, by pinching it up with a forceps, and cutting horizontally as in opening a hernial sac. If this vein bulge so much as inconveniently to cover the artery, a finger may be pressed over it in the upper part of the incision, with the effect of diminishing the quantity of descending blood. The artery is the most internal of the three objects within the sheath, the vein being the most external; while the pneumogastric nerve lies between the two vessels, and rather behind them. The artery being now sufficiently exposed in front, a slightly curved aneurismal needle armed with ligature is passed round it, from without inwards, so as to preserve the vein and nerve from injury, and the latter from being included by the thread. The operation is then finished according to the general rules previously laid down.

When we wish to secure the primitive carotid, whether on account of the existence either of aneurism or wound of its branches, the superior operation is to be preferred on account of the comparatively superficial situation of the vessel; but when the aneurism occupies the trunk, we are obliged to place the ligature below, where the artery is crossed by the omohyoid muscle: in which case the operation is called the inferior, and is more easily performed on the right side than on the left; but it is likewise more dangerous, because the proximity of the subclavian

Fig. 244. From Liston.

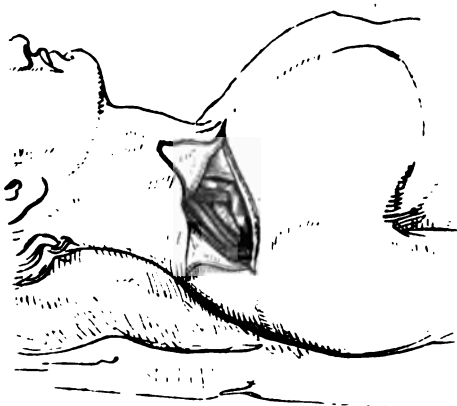
will increase the difficulty of the formation of the internal coagulum in the origin of the carotid. The first incision should be about three inches in length, commencing immediately above where the artery is crossed by the omohyoid, and extending along the course of the vessel. After cutting through the skin, subcutaneous, cellular and adipose tissue, the platysma myoides, and the cellular tissue beneath, the sterno-mastoid is to be drawn backwards, and the sterno-hyoid and sterno-thyroid forwards, when the deep cervical fascia is brought into view; after which the remaining steps are to be proceeded with as in the superior operation.

DELIGATION OF THE SUBCLAVIAN ARTERY.

[This artery was first tied by Mr. Ramsden, 1809, although Sir Astley Cooper attempted it in the early part of the same year. The first successful case occurred to Dr. Post, of New York, in 1817.—Ed.]

The operation of tying the subclavian artery on the acromial side of the anterior scalenus muscle may be required in aneurism of the axillary artery, and may be performed in the following manner:—The patient being placed in the recumbent posture, with the shoulder depressed as much as possible, the head slightly inclined to the opposite side, and the integument in front of the chest drawn down by an assistant, the surgeon divides the skin upon the clavicle, from the acromial border of the sterno-mastoid muscle to the clavicular attachment of the trapezius. On the hands of the assistant being removed, the wound rises above the clavicle, becoming parallel to it in the under

Fig. 245.



region of the neck. A short incision along the posterior border of the sterno-mastoid muscle is made to end in the first line of the wound. The platysma myoides and fascia should then be cautiously divided, care being taken after division of that muscle not to injure the external jugular vein, which passes down under the muscle near

Fig. 245. From Liston.

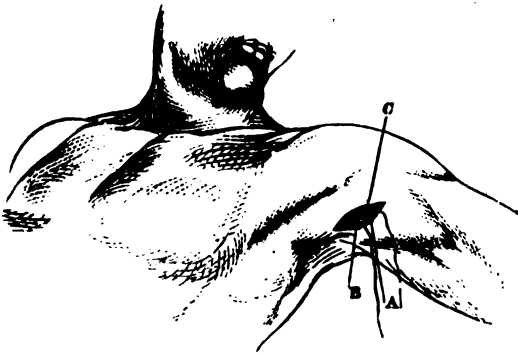
the middle of the horizontal incision. On dividing the cellular tissue along its inner border, the vein can, in general, be easily kept out of danger, by being gently drawn to the acromial aspect of the wound by means of a copper spatula. The various tissues having been divided, from the acromial margin of the sterno-mastoid to the inner border of the omohyoid muscle, the cellular tissue covering the small triangle formed by the two scaleni muscles and a portion of the first rib should next be divided, and the suprascapular artery held towards the scapula by another copper spatula. The acromial border of the anterior scalenus muscle should be exposed; and on tracing it down to the first rib, the artery will be found in the angle formed by that margin of the muscle and the first rib, lying internal and inferior to the lower fasciculus of the brachial plexus. The ligature is then passed underneath the artery by an aneurismal needle; and, in doing so, the preferable proceeding is, to direct the convexity of the instrument towards the clavicle, to apply its point close to the artery, and to carry it round in such a way as not to disturb the artery, except above, to a greater extent than is produced by the track of the needle. When the ligature cannot be drawn by the fingers pressed down on the vessel, it may be run close by means of a notched probe. The principal risks to be guarded against in performing this operation are,—wounding the external jugular vein, the suprascapular artery, and the subclavian vein;—detaching the artery from its surrounding connexions to an undue extent; or, mistaking a fasciculus belonging to the brachial plexus for the artery. In connexion with this operation, it should be borne in mind, that a large communicating branch sometimes runs superficially to the clavicle between the cephalic and external jugular veins, which, when present, would probably be divided in the first incision. The sterno-mastoid and trapezius muscles are occasionally attached to a much greater length of the clavicle than usual, and in such a case their fibres to some extent must necessarily be divided, in order to obtain an external wound affording sufficient freedom. The omohyoideus also has been known to contract an additional attachment to the clavicle near its scapular extremity.

DELIGATION OF THE AXILLARY ARTERY.

The axillary artery may be tied with great facility in its lower third, below the origin of its subscapular and circumflex branches, when the arm is abducted and rotated outwards very much, in which position the anterior fold of the axilla is removed from the vessel. The forearm should be kept supinated and slightly bent, so as to prevent painful tension of the nerves. The guide to the artery here is the inner margin of the coraco-brachialis muscle; and the pulsations can also be easily felt. An incision, about three inches long, is made in the direction indicated, cutting through the tense integument and the subcutaneous cellular tissue. Then the deep fascia being completely divided, the median nerve is exposed, lying in front of the artery. The arm may now be lowered somewhat, so as to relax the parts, and permit the median nerve to be drawn aside, and facilitate the easy passage of the aneurismal needle round the artery. This is effected from within outwards, in order to secure from injury the axillary vein, which lies internal and anterior to

the artery, as well as the internal cutaneous and ulnar nerves, which lie on its inner aspect. The radial nerve is behind, but in little danger.

Fig. 246.



It must be remembered that the humeral veins sometimes run up for some distance in the axilla, before they unite to form the axillary; and also, that the artery sometimes divides in the same space into two branches, which afterwards become the radial and ulnar.

DELIGATION OF THE HUMERAL ARTERY.

The humeral or brachial artery may be tied in any part of its course. The arm is to be abducted, and sufficiently rotated outwards, while the forearm is supinated, and, after the first incision, slightly flexed. The guide to the vessel, in the upper portion of its course, is the inner margin of the coraco-brachialis; in the middle and lower parts, that of the biceps; and in the lower portion of the arm, that of the tendon of the last muscle. In the former situations, the external incision should be about three inches in length; in the latter, it may be somewhat shorter. The integument and superficial fascia are first cut through; after which the deep aponeurosis is cautiously divided, the basilic vein being drawn inwards and out of danger. The internal cutaneous nerve in the upper part of its course lies near the line of incision, but in the lower, becomes internal to the vessel, and the deep brachial veins embrace the artery laterally, and frequently communicate by cross branches which pass in front or behind. These communicating twigs are to be avoided. The occasional high division of the brachial artery must be remembered. When this occurs, the two vessels

Fig. 247.



run side by side, and are evidently much smaller than the single trunk usually present. Before finally tightening the ligature, it is necessary to observe, by the effect of compression, which vessel is chiefly implicated in the disease. Probably both will require deligation. It is worthy of remark, that of the two vessels, the one which afterwards becomes the ulnar, furnishes nearly all the regular branches normally distributed by the humeral artery.

DELIGATION OF THE RADIAL AND ULNAR ARTERIES.

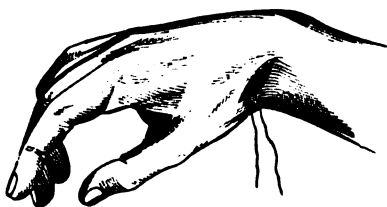
The radial artery may be tied on the anterior aspect of the forearm, by making an incision from two to three inches in length, carried along the inner margin of the supinator radii longus in the upper portion; but in the lower part, along the outer edge of the tendon of the flexor carpi radialis, which can here be more distinctly traced than that of the former

Fig. 248.



muscle. The course of the artery in this region corresponds with a line drawn from midway between the condyles of the humerus, obliquely downwards and outwards, to a point a little internal to the styloid process of the radius. After cutting through the skin, and the superficial and deep fascia, the artery is found accompanied by venæ comites. In the middle third of the arm, a nerve—the radial branch of the musculospiral, or, according to a different nomenclature, the dorsal cutaneous branch of the radial nerve,—lies at a little distance on the radial side of the vessel; but it is scarcely in the way of the needle; and elsewhere, it is still farther removed. The radial artery may also be tied on the dorsum of the hand, before it dips into the space between the first and second metacarpal bones on its way to the palm. The incision is made along the extensor tendon of the extreme phalanx of the thumb,

Fig. 249.



either on its radial or ulnar aspect, according as the thumb is approximated to, or abducted from the index finger. The skin, cellular tissue, and a delicate dorsal fascia are divided, along with some minute nervous and venous twigs. The ulnar artery may be tied in the middle and lower third of the forearm, or at the wrist. In the lower third, it is easily exposed by

an incision of two or three inches in length, carried along the radial border of the tendon of the flexor carpi ulnaris, through the skin and

the superficial and the deep aponeurosis. The artery is found lying close on the radial side of the tendon, and rather deeper. The ulnar nerve is here applied rather closely on the ulnar aspect of the vessel, and is accordingly to be avoided by passing the needle between them from the ulnar towards the radial side. The *venæ comites* are at the same time to be preserved from injury. In the middle third, the artery is rather deeply situated, but may be reached by a free incision, guided by tracing up the tendon of the flexor carpi ulnaris, on the radial side of which muscle the division of the integument, fascia, and deep aponeurosis is to be effected. The artery is exposed between the muscle already named and the superficial flexor of the fingers. Here also the ulnar nerve is found on the ulnar side of the vessel. At the wrist, this artery may be tied, after dividing for about two inches the integument and fascia along the radial side of the pisiform bone and the tendon of the ulnar flexor, in which situation the vessel is found, having the nerve still related to its inner side.

THE EXTERNAL ILIAC ARTERY.

[To Abernethy belongs the credit of first tying this artery. The case terminated successfully.—Ed.]

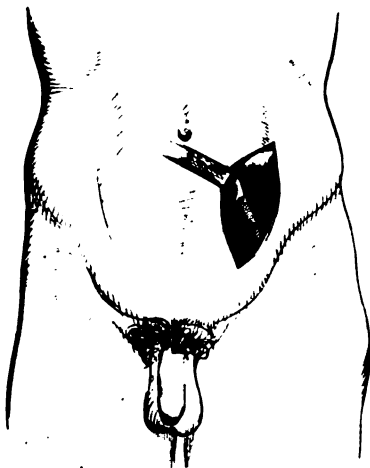
The external iliac artery is secured in the following manner:—The patient is placed with his shoulders well raised, and the thighs slightly flexed, so as moderately to relax the abdominal parietes. An incision, from four to five inches long, but varying in length according to the corpulence of the individual, is commenced a little above the centre of Poupart's ligament, and carried upwards with a slight inclination outwards, so as nearly to correspond with the course of the fibres of the tendon of the external oblique muscle, named by many the anterior layer of the abdominal aponeurosis. In this first incision the integument and superficial fascia are divided. The aponeurotic fibres just mentioned are separated along the line of wound with as little cross-cutting as possible. The fibres of the internal oblique and transversalis muscles are next divided very cautiously, employing the forceps when necessary. The part of the transversalis fascia, which at the internal aperture of the inguinal canal is thinned, and sends off a tubular prolongation downwards over the spermatic cord, is pinched up at this spot, and opened immediately externally to the cord with great caution, so as not to wound the peritoneum which lies directly behind. The finger is now inserted into the aperture thus made in the transversalis fascia, and gently insinuated between it and the peritoneum, with which guard against wounding that membrane, the fascia is divided, like the other layers, upwards and outwards to the same extent. During the progress of the operation the margins of the wound are to be kept well apart by means of bent copper spatulæ. The peritoneum is then detached at the lower and outer aspect of the wound, and as far as requisite from the iliac fascia, by gently insinuating the fingers and opening up its delicate cellular connexions, which at this part are remarkably loose. The inner margin of the wound, and the peritoneal sac, are now drawn inwards so as to expose the vessels. The artery is separated from the vein, which lies on its inner and posterior aspect, by a scratch with the point of the scalpel, and that sufficiently to permit

the introduction of the point of the aneurismal needle between them, at some little distance above the origin of the deep epigastric artery, carrying the instrument from within outwards. When, owing to the thickness of the abdominal parietes and the consequent depth of the artery, it is impossible to encircle it with the common needle or to tighten the knot by pressing the fingers down on each entwinement, then Weiss's aneurismal needle and the notched probe may be employed to accomplish these ends. After operation, the parts are replaced, the wound being maintained in apposition by a few sutures, while the limbs are still farther raised, so as to relax the abdominal parietes and the deligated vessel.

THE COMMON ILIAC ARTERY.

[No one had attempted the tying of the common iliac artery until 1827, when it was successfully performed by Dr. Mott, of New York. —Ed.]

Fig. 250.



The common iliac artery is reached by proceeding in the same way as above described for the external iliac. This vessel is traced up until the primitive trunk is discovered. The external incision must, however, be longer, varying from five to six inches; and the peritoneum requires detachment to a greater extent upwards and inwards. The ureter crosses in front of this vessel, near its bifurcation, but is usually raised up along with the peritoneum; if not, it must be avoided. It should also be remembered, that while the vein of each side lies posterior to its corresponding artery, the vein of the

right side inclines also a little to the outer aspect, and that of the left to the inner aspect of the vessel which may require deligation.

THE INTERNAL ILIAC ARTERY.

[This vessel was secured in a ligature by Dr. Wm. Stevens of St. Croix, West Indies. The operation was performed for gluteal aneurism on a negress.—Ed.]

The internal iliac artery may be tied by a similar proceeding to that for the common iliac. It will be found by tracing up the external iliac to the point at which the primitive vessel bifurcates on the sacro-iliac junction. The ureter crosses in front and the vein lies behind. The latter, however, on the right side is also a little external, and on the left it is somewhat internal to the artery.

DELIGATION OF THE COMMON FEMORAL ARTERY.

Deligation of the common femoral artery is a very easy, though not

Fig. 250. From Liston.

likely to be a very successful operation, on account of the proximity of the ligature to the origins of the epigastric and circumflex iliac vessels above, and that of the profunda femoris below. The artery emerges from beneath Poupart's ligament, midway between the anterior superior spine of the ilium and the spine of the pubes. Its pulsations, moreover, in the natural state of parts, are easily felt. The skin may be divided by an incision of two or three inches in length downwards from a little below Poupart's ligament. The saphena major vein being then drawn aside, if in the way, the loose cellular tissue and any glands present are carefully cut through. The fascia and proper sheath are then opened, and the point of the scalpel employed, if necessary, to scratch the cellular tissue between the vessels, and afford a commencement to the entrance of the aneurismal needle, which is carefully passed from within outwards, so as not to injure the vein, which lies internal to the artery.

The fittest point at which to secure the femoral artery after it has given off the profunda, is, immediately before it runs beneath the sartorius in the angle formed by that muscle and the adductor longus. The vessel may usually be traced by its pulsation downwards and inwards from the centre of Poupart's ligament. The incision should pass over the angle formed by the sartorius and the adductor longus, should be directed downwards and a little inwards, be about three inches in length, and cut through the integument and superficial fascia. The fascia lata is pinched up by the dissecting forceps, and carefully divided, avoiding any twigs of the anterior crural nerve, which are here found in front of the artery as the incision deepens. Lastly, the sheath found in the angle mentioned above is opened with the usual caution, for about half an inch.

The femoral artery and vein are much more intimately covered and connected together by cellular substance than any other vessel. Accordingly, the former must be cleared of this loose tissue for a minute space in front, till its external tissue is seen distinct and white, the forceps and point of the scalpel being employed in this delicate part of the operation. Then the aneurismal needle may be safely and easily passed round the vessel, from within outwards, the vein lying internal and posterior, and the nerve on the outer or iliac side. It must be remembered, that the femoral artery is, like the humeral, some-

Fig. 251.

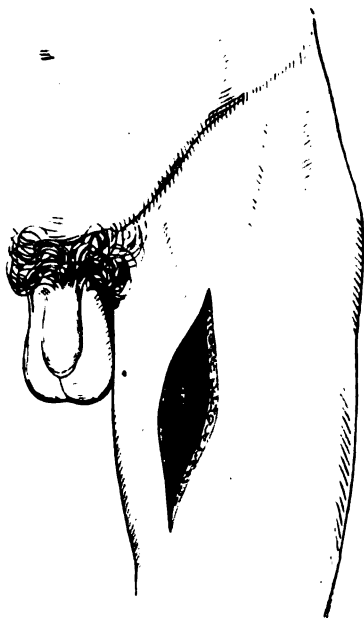


Fig. 251. From Liston.

times found double, and that deligation of one of the vessels would probably fail in producing the desired result.

THE POPLITEAL ARTERY.

The popliteal artery is now very seldom made the subject of operation, though the disease in it frequently necessitates deligation of the femoral. It may be secured by making an incision, about four inches in length, down the centre of the popliteal region, commencing in the upper part of this space, and cutting through the skin and superficial fascia. Subsequently the aponeurosis is divided, and the surgeon cautiously deepens the dissection along the outer margin of the semitendinosus and semimembranosus muscles. The vessels are at last reached, lying in a quantity of cellular tissue; and when this is sufficiently cleared aside, the vein is discovered lying superficially to the artery. The former must be gently drawn aside, and the intimate cellular connexion between it and the artery being loosened at one point by a delicate touch with the point of the scapel, the needle may be gently insinuated and passed around the latter from within outwards, a little higher up than the plane of the knee-joint. The internal popliteal nerve, lying superficially to the artery, and towards its outer side in this part of the space, must, if exposed, be drawn out of danger. The popliteal vein has also a slightly external, as well as a posterior relation to the artery.

THE ANTERIOR TIBIAL ARTERY.

The anterior tibial artery is easily reached in the lower third of the

Fig. 252.



leg, by an incision, two or three inches in length along the outer side of the tendon of the tibialis anticus, cutting through skin, superficial fascia, and the deep aponeurosis of the leg. The artery here lies on the outside of that tendon, between it and that of the extensor proprius pollicis, with the corresponding nerve in front, and a vena comites on either side. If the incision be made too far down, the tendons of the extensor proprius pollicis would be found crossing over in front of the artery, in immediate proximity to the ankle-joint.

On the middle third of the leg, this vessel lies deeper and requires an incision of proportionate length, which is guided either by selecting the middle line between the crest of the tibia and the borders of the fibula, or by tracing up the tendon of the tibialis anticus, along the outer margin

Fig. 252. From Liston.

of which muscle the division is to be effected. After separating this muscle from the extensor proprius pollicis, the artery is found between them, with its venæ comites placed as usual, and the anterior tibial nerve lying generally in front.

In the upper third of the leg, this artery lies very deep, being covered by the apposition of the tibialis anticus on its inner side, with the extensor longus digitorum on its outer aspect. The incision must be at least four inches in length; and is to be carried down in the central line, between the crest of the tibia and margin of the fibula. The skin and superficial fascia being divided are drawn apart, and the muscular interspace is sought for by moving the foot, and so making the muscles start up; or it can generally be observed by a yellow line, marking the spot where the aponeurosis is thickened at the attachment of the intermuscular septum. Moreover, the cutaneous incision made in the course indicated corresponds almost exactly with this interspace. The deep fascia is then divided along this line, and the separation of the muscles effected by the handle of the scalpel, or if necessary, by its edge also. The artery is at last found, with a venæ comites on each side; and the nerve in this situation lying on its outer aspect. The aneurism needle may then, with the usual precautions, be passed from the fibular to the tibial side.

DELIGATION OF THE POSTERIOR TIBIAL ARTERY.

The posterior tibial artery may be tied behind the inner ankle, when the foot is flexed and turned inwards, by making an incision midway between the internal malleolus and the tendo Achillis, curving gently forward at its lower part, and extending to two or three inches in length. The skin and superficial fascia are cut through, and subsequently the strong aponeurosis is divided, when the artery will be found, accompanied on either side by a vein, and by the posterior tibial nerve on its outer aspect towards the tendo Achillis. The tendon of the flexor proprius pollicis is also placed on the fibular aspect of the artery, and those of the flexor longus digitorum and tibialis posticus run on its tibial side, or near the inner ankle. The foot should be slightly extended, while the needle is being passed from the tibial to the fibular side, so as to relax the tissues and facilitate its transit.

In the middle of the leg, deligation may be effected by making a very free incision between the tibia and the margin of the gastrocnemius, which

Fig. 258.



Fig. 258. From Liston.

muscle is drawn aside. The soleus is next detached from its tibial origin, and is also pulled aside. Lastly, the deep layer of the tibial aponeurosis is divided, and the vessel reached, accompanied by its *venæ comites* and the nerve, which, about the middle of the artery, lies superficially to the vessels. If deligation be required on account of a wound of the artery, the vessel must be tied above and below the seat of the injury.

DELIGATION OF THE DORSAL ARTERY.

The continuation of the anterior tibial artery on the dorsum of the foot, known as the dorsal artery, may be tied about the middle of its course, by making an incision through the skin, fascia, and aponeurosis, along the outer or fibular side of the tendon of the extensor proprius pollicis, where the artery will be found, with the innermost tendon of the extensor longus digitorum on its outside. A vein runs on either aspect, as usual, and the continuation of the anterior tibial nerve runs externally and superficially to the artery.

CHAPTER XX.

AFFECTIONS OF THE RECTUM.

RECTITIS, OR INFLAMMATION OF THE RECTUM.

Causes.—Rectitis may be produced by extension of inflammation from neighbouring parts, — by external injury, — by hemorrhoids in an inflamed state, — by alterations of temperature, — by foreign or irritating substances in the bowel, — or by operations performed on the rectum or near it. Sometimes, though very rarely, it occurs as an idiopathic disease.

Symptoms.—In acute rectitis, in addition to the usual symptoms of very smart irritative fever the patient experiences a sense of fulness and weight in the rectum, a bearing down, a distressing burning heat, and excruciating pain, aggravated to a most agonizing extent by tenesmus and contraction of the sphincter muscle.

In many cases there is, after a short time, a scalding discharge of a muco-purulent matter, and in most instances the urinary organs sympathize, so that, in addition to the symptoms affecting the rectum, the patient is distressed with strangury, or painful micturition, or even with retention.

Treatment.—The treatment consists in removing, if possible, the cause of the disease, in confining the patient to the recumbent position, in enjoining the strict observance of the antiphlogistic regimen, in instituting local depletion by the application of leeches around the anus, in obviating constipation by the use of the mildest enemata, in the diligent and efficient employment of warm and emollient applications, and in allaying the tenesmus, contraction of the sphincter ani, pain of the rectum, and the distressing symptoms affecting the urinary organs, by the use of opiates, which may be applied to the rectum in the form of enema, or by suppository, or diffused through ointment: in some instances it is necessary to give them by the mouth.

Ulceration of the rectum, deposit of lymph between the coats, — laying the foundation of stricture, — perforation of the rectum by ulceration, extension of inflammation to the surrounding cellular tissue — producing abscess in the first instance and afterwards fistula — are some of the consequences of this painful affection when not speedily subdued; and in order to their prevention, the treatment should be as energetic as the circumstances of the case seem to justify.

FISTULA IN ANO.

When a fistula has an external and internal opening, it is said to be complete; when an external opening only, it is called a blind external,

and when it has only an internal opening, a blind internal fistula ; in the two latter cases the fistula is said to be incomplete.

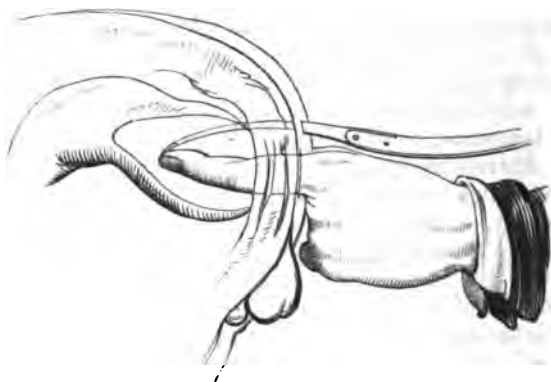
This affection is much more common in men than in women, and the period of life at which it most frequently occurs is between twenty and fifty years of age. The situation of the external opening is usually at the side of the anus, very rarely either before or behind ; and with regard to the situation of the internal opening, M. Ribes found, on examining seventy-five bodies in which fistula existed, that in all cases in which there was an internal opening, it was not high up, but immediately within the sphincter muscle. This observation accords with the experience of Sabatier, Larrey, and many others.

Before performing an operation for the cure of fistula, it is of the greatest importance to ascertain that the disease is entirely local, in which case the desired result will be obtained ; whereas, if the disease be connected with pelvic abscess, or with disease of the sacrum, or with organic disease of the lungs, liver, or any other important internal organ, the surgeon will bring discredit on himself by recommending an operation.

Sir Astley Cooper remarks, " The surgeon often brings discredit upon himself by operating in these cases in the last stage of *phthisis* ; and when it is impossible that the disease can be cured ; therefore, that death which is the result of pulmonary disease is falsely attributed to the *fistula in ano*."

Sir Benjamin Brodie observes, " In those cases in which a *fistula in ano* occurs in connexion with some organic disease of the lungs or liver I advise you never to undertake the cure of the fistula. No good can arise from an operation under these circumstances ; but if you perform

Fig. 254.



it, one of two things will happen—either the sinus, although laid open, will never heal, or otherwise, it will heal as usual, and the visceral disease will make more rapid progress afterwards, and the patient will die sooner than he would have done if he had not fallen into your hands."

Fig. 254. From Liston.

The frequent motion caused by the contraction of the sphincter ani being the principal obstacle to the healing of fistula in this situation, the immediate object aimed at by operation is the division of that muscle. In complete fistula this may be readily accomplished by introducing the forefinger of one hand into the rectum, introducing a curved blunt-pointed bistoury through the fistula into the rectum, resting the point of the forefinger against the back of the point of the instrument in the rectum, bringing it down through the anus, and dividing the sphincter. The instrument should always be made to pass into the bowel through the internal opening, and the parts below it divided; but any division of the bowel above that opening is perfectly unnecessary. When no internal opening exists, the bistoury should be pressed into the bowel at the usual situation of that opening, where the coats of the rectum will be found to be attenuated; and when there is no external opening, the integument covering the under part of the fistula, which will be found thin and unsupported, and surrounded by a part which feels thick and hardened under the adjacent portions of the skin, should be divided so as to make an external opening, and then the same operation as for complete fistula is performed. A little lint dipped in oil should be introduced immediately after the operation, and the parts afterwards dressed for some days with lint soaked in some lotion.

HEMORRHOIDS.

Hemorrhoids, or piles, are swellings at the verge of the anus, presenting varieties both as to situation and nature.

The *Causes* of hemorrhoids have been arranged into predisposing and exciting. To the former class may be referred habitual constipation, sedentary occupations, pregnancy, abdominal tumours, some affections of the liver, and any condition capable of retarding the circulation in the portal system, or of preventing the free return of the blood from the veins of the rectum. To the latter class belong straining at stool—irritation of the rectum induced by hardened fæces, by purging, or by tenesmus—sympathy of the rectum with affections of the urinary bladder—and long maintenance of the erect posture, by which the flow of blood is rendered difficult in the portal system, unprovided as it is with valves. Such are some of the predisposing and exciting causes. The rationale of their operation will be readily perceived, when the nature of hemorrhoidal swellings is explained.

Varieties as to Situation and Nature.—Hemorrhoids are called external or internal, according as they are without or within the sphincter ani.

External Hemorrhoids.—With regard to anatomical characters, external hemorrhoids may be said to consist of a varicose condition of some of the hemorrhoidal veins. The veins may be merely dilated and the cellular tissue around them in a natural state; or they may be dilated and inflamed, presenting the varieties with regard to condition of coats and contents mentioned in the description of the parts in phlebitis, with the surrounding cellular tissue more or less inflamed, or containing products of inflammation, or, if the hemorrhoids have been of long standing, more or less hypertrophied. While external hemor-

rhoids continue in a quiescent and indolent condition, the contents of the dilated veins remain in a fluid state, and comparatively little discomfort is experienced; but when they become inflamed, the pain and bearing down are great. The coats of the distended vein may at some parts give way, and a discharge of blood take place, constituting what has been termed open or bleeding piles; or the contents may become consolidated, as in the forms of phlebitis in other parts of the body; or abscess may be the result.

Internal Hemorrhoids.—Of these there are three varieties. First, those which consist of erectile tissue which seems to be developed principally in the submucous cellular tissue.—Second, those which are of the same nature as external hemorrhoids, consisting of portions of varicose veins covered by mucous membrane, and presenting the same varieties as to quiescence or irritability, and as to condition of coats and contents, with this difference, that they cause much more uneasiness and are attended with more sympathetic irritation,—the symptoms affecting the urinary organs being often very distressing.—The third variety, which rarely occurs, consists of those which are of the nature of simple sarcoma.

Treatment.—The treatment may be either palliative or radical.

The palliative treatment of external hemorrhoids when in a state of inflammation consists in the removal of the cause, if possible and proper, in local depletion by means of leeches, and in some cases by the free division of the hemorrhoid, in regulating the bowels by gentle, non-irritating medicines, in the occasional use of the warm hip-bath, and in the strict observance of the horizontal position. In the chronic stage, the local part of the palliative treatment consists in the use of cold applications and astringents.

The palliative treatment of internal hemorrhoids when in a state of inflammation, may be said to consist in the employment of the remedies already mentioned as proper in the treatment of rectitis.

• The radical treatment proper to be instituted, having for its object the removal of the hemorrhoids, differs greatly according as the hemorrhoids are external or internal. In the former case, the proper and easy proceeding is, to remove them by the knife or the scissors; whereas internal hemorrhoids, with the exception of the comparatively rare variety in which they are of the nature of simple sarcoma, can be safely removed only by ligature. The great danger of hemorrhage, and the difficulty of averting it, have led almost all surgeons of much experience to this conclusion. The mode of proceeding is as follows:—The bowels having been well moved, the hemorrhoids are made to protrude by straining, and the nates being separated from each other by an assistant, the tumours are seized with a volsellum, and the surgeon ties them firmly by means of a silk thread round their roots, if they be small and pendulous; if otherwise, they may be transfixed at the base by a needle, and one-half included in each of the threads. The ends of the threads should then be cut off, the strangulated portions of bowel and that protruded carefully returned, and the patient confined to the horizontal position until the ligatures come away. An opiate should be given to allay pain and prevent motion of the bowels, and the state of the

urinary organs attended to. If the patient complain of much discomfort, warm fomentations and poultices may be applied.

To the benefit and satisfactory results of this method of treatment, I am sure that all surgeons who have had sufficient experience of it will be able to give the most favourable testimony. In cases in which the principal characteristic is a diseased condition of the mucous membrane placed over varices or altered cellular tissue—a form in which there is great irritation and often considerable loss of blood—Mr. Houston has used with advantage the nitric acid. The bowel having been made to protrude, and the part having been wiped with lint, the acid is applied to a small part; this is followed by the application of some oil to the same part, and the return of the protruded portions of the bowel; after which an opiate is given. The surface is said in general to heal very rapidly after the separation of the superficial slough. I cannot say anything of this mode of treatment from personal observation, but in the class of cases above referred to, the result has been found by Mr. Houston and some others to be very satisfactory.

RHAGADES.

Fissures, excoriations, and cracks are very frequently met with at the verge of the anus, especially in persons much troubled with disorder of the digestive organs. They cause much pain, which is greatly increased while the bowels are being moved, and for a considerable time afterwards. They also give rise to spasm of the sphincter, which aggravates the pain; and if of long standing, they lead to permanent stricture. It is surprising how much suffering often results from a very small fissure in this situation.

By the careful regulation of the bowels, attention to diet, and local treatment consisting of application to the part of nitrate of silver, or nitric acid, this troublesome complaint is sometimes removed; but more frequently an operation is necessary, the object of which is to convert the fissure into a simple wound. This is effected by making a slight incision passing through the fissure, and dividing, according to the extent of the fissure, either the mucous membrane and submucous cellular tissue alone, or these parts together with the sphincter, so as to set the parts at rest; after which they heal up very kindly under the treatment for a simple wound, and the disease is removed.

I have performed this operation in many cases, and never found it necessary to do more than make a longitudinal incision through the mucous membrane and the submucous cellular tissue; but many surgeons state that, in cases occurring in their experience, it has been requisite to divide the sphincter also.

PROLAPSUS ANI.

Prolapsus ani may be either partial or complete, and it may occur in children, in adults, or persons of an advanced age.

PARTIAL PROLAPSUS.

Partial prolapsus, which consists in protrusion of a portion of the mucous membrane, is chiefly met with in adults, is almost invariably induced by internal hemorrhoids, and is immediately caused by exertion.

The treatment of this variety,—called by some authors partial prolapsus, by others prolapsus from hemorrhoids,—may be clearly understood from what has been stated regarding the treatment of internal hemorrhoids.

COMPLETE PROLAPSUS.

Complete prolapsus presents the appearance of a swelling, for the most part of a globular form, and consists of an invagination of a portion of the bowel, constituting a condition similar to that which within the abdomen is called intus-susception.

Complete prolapsus may be said to be almost entirely confined to infancy and childhood, and old age. In early life it is almost invariably induced by straining at stool, tenesmus, or violent crying; and any condition by which these causes are called into existence may lead to prolapsus, such as an acrid condition of the contents of the bowels, irritation of the mucous membrane, the presence of worms, pain in the bowels, calculus in the bladder, or the irritation of teething. This form of prolapsus has been called prolapsus from irritation. The treatment consists in returning the protruded part, and in using the proper means to prevent a recurrence of the protrusion.

There are various proceedings by which the protruded parts may be returned. One is, having placed the patient in the horizontal position on his back or side, with the limbs drawn towards the abdomen, and, having oiled the parts, with one hand to compress the neck of the tumour, and with the other to press up the swelling within the sphincter. While these manipulations are being performed, the patient should endeavour to avoid straining, which, by compressing the abdomen, would render replacement more difficult. Another very satisfactory mode is, to lay the patient on his face, to spread a dry towel over the protruded parts, and then to send a finger gently up into the rectum. The bowel adheres to the towel, and is carried up along with it. The margin of the anus should be compressed, while first the finger and then the portion of towel are being withdrawn.

The treatment for the prevention of reprotrusion must depend on the condition by which the exciting cause of the prolapse is brought into operation.

In persons of an advanced age, prolapsus for the most part occurs from weakness and want of retaining power of the sphincter. This form has consequently been called prolapsus from weakness. Some of its causes are coughing, the erect posture, and walking to an extent to induce fatigue. After reduction, support by means of a compress and T bandage is necessary; and the treatment for preventing a recurrence of the prolapse must be adapted to the particular circumstances of the case.

From what has been stated, it is hoped that the causes, the conditions, and the treatment of the three forms of prolapsus, namely, from hemorrhoids, from irritation, and from weakness, will be clearly understood.

STRICTURE OF THE RECTUM.

I. SIMPLE ORGANIC STRICTURE.

Seat.—This affection is commonly situated in the lower part of the rectum, about two or three inches from the verge of the anus, so that it can be readily reached with the finger, and its existence ascertained by examination. In some few instances it may have been found higher up, and some writers have expressed themselves with much confidence that this is its usual situation; but dissection has shown, and all the greatest authorities are agreed, that it is almost invariably in the lower part of the rectum.

Symptoms.—The principal symptoms are pain, difficulty and straining during defæcation,—the fæces when solid being passed in small, flattened and narrow fragments, and, when fluid, ejected very forcibly. Of the early symptoms, difficulty of voiding the contents of the bowels is the most characteristic; and at an advanced period of confirmed stricture, the very frequent and forcible discharge of thin fæces, with a copious secretion of mucus frequently tinged with blood—a consequence of irritation of the mucous membrane—is one of the most remarkable features. Such are the principal symptoms, but it is by examination that the existence of stricture is ascertained with certainty. Sympathetic irritation of the bladder, pains in the back and legs, disorder of the digestive organs, and general debility, occur as the disease advances; and when not cured, it proves fatal for the most part by inflammation of the bowels, or by gradual sinking of the patient's strength.

Condition of Parts.—There is a striking analogy between the condition of parts in stricture of the urethra and in that of the rectum. In each case the stricture, although in some slight degree constituted by induration and thickening of the coats of the canal in which it is situated, is chiefly—it might almost be said, entirely—constituted by deposit into the submucous cellular tissue; in the urethra, the part behind the stricture becomes dilated; in the rectum, the part above; in the urethra, the mucous membrane behind the stricture in many cases becomes ulcerated, giving rise to fistula in perineo; in the rectum, the mucous membrane above the stricture occasionally becomes ulcerated, giving rise to fistula in ano; in stricture of the urethra, there is sympathetic irritation of the rectum; in that of the rectum, there is sympathetic irritation of the urinary organs; and in disease of either canal, if not cured, death may be caused by gradual exhaustion, or by disease of more internal parts.

Treatment.—The treatment of stricture of the rectum consists in attention to the condition of the bowels, and in the cautious use of the bougie, with the view of restoring the canal to its normal size. The rationale of the treatment of stricture of the rectum by means of the bougie, is the same as that of the similar treatment of stricture of the urethra. The object aimed at in both instances is, to excite absorption by pressure; and in both great care must be taken not to use the instrument so often, or to allow it to remain so long as to produce irritation, which

would aggravate the disease instead of alleviating. The simple introduction of the instrument is sufficient, and after the first operation, it is advisable to commence by inserting the bougie passed on the previous day, and immediately withdrawing it to introduce one of a larger size. This proceeding may be repeated every third or fourth day, or at longer or shorter intervals, according to the time necessary for the subsidence of all uneasy sensations caused by the previous operation. Sometimes, even after the most gentle and careful use of the bougie, it is necessary to have recourse to the hip-bath and to opiate injections, in order to allay the irritation produced. In some cases, the stricture has been divided by slightly notching it at different parts by means of a blunt-pointed curved bistoury introduced upon the finger, after which the bougie is employed for the purpose of dilatation; but the very great risk of hemorrhage, the difficulty of checking it, and the danger of inflammation from wounds of the rectum, are serious objections to this proceeding, which should only be resorted to in extreme circumstances, and then with the utmost possible caution.

II. MALIGNANT STRICTURE OF THE RECTUM.

The principal points in which the symptoms of this affection differ from those of the former are, that they are much more severe; there is a constant dull shooting pain in the part affected, and in the back, extending down the limbs; there is an extremely offensive discharge of blood and matter from the part; ultimately the power of retaining the contents of the bowels is lost: and the symptoms affecting the urinary organs are much more distressing. The patient loses flesh and strength; his countenance assumes a yellow appearance, characteristic of malignant disease; and he presents the other symptoms of constitutional cachexy. The rectum is very irregular on its internal surface, and is usually affected along a considerable extent. Palliation is the only treatment the disease admits of.

CHAPTER XXI.

AFFECTIONS OF THE EYE AND ITS APPENDAGES.

OPHTHALMIA.

ALL inflammatory affections of the eye-ball and conjunctiva are comprehended under the general term, Ophthalmia.

INFLAMMATORY AFFECTIONS OF THE CONJUNCTIVA.

Of conjunctivitis, or inflammation of the conjunctiva, there are several varieties, of which the principal are, 1. *Simple*, 2. *Pustular*, 3. *Catarrhal*, 4. *Purulent*, and 5. *Strumous conjunctivitis*.

I. SIMPLE CONJUNCTIVITIS.

This affection is by some authors described under the more general term, ophthalmia simplex.

Symptoms.—The principal symptoms are, pain of a sharp pricking character, a distressing sensation of heat and stiffness, a feeling as if sand or some other extraneous matter were lodged on the surface of the membrane, intolerance of light, and lachrymation; and on opening the eyelids, the conjunctiva is found to present a red appearance of a scarlet tint, with a peculiar arrangement of the vessels, which requires to be carefully noticed for distinguishing inflammation of the conjunctival covering from inflammation affecting the deeper textures of the eye. The arrangement of blood-vessels characteristic of this affection is called reticular, and is represented in the accompanying drawing. The vessels are superficial, large, and tortuous in their course from the orbital circumference of the membrane towards the margin of the cornea; they can be drawn aside or moved by dragging the eyelids with the finger, or by communicating movements to the membrane; they anastomose very freely with each other, and produce a beautiful web-like, or network appearance. In very severe cases the minute vessels become so much distended as to make the reticular arrangement less distinct, or altogether imperceptible; and in place of it the membrane exhibits a uniform florid hue, with a very irritable appearance. There is slight febrile action in severe cases, but in others there are scarcely any constitutional symptoms.

Causes.—Both the predisposing and exciting causes are numerous. Among the former are disorder of the digestive organs, functional disorder of the

Fig. 255.



skin, and derangement of the general health however induced; and of the latter some of the most common are, exposure to cold winds, atmospheric changes, inversion of eye-lashes, direct injury, lodgment of foreign matter, as dust or sand, between the eyeball and the eyelids, and the application of mechanical or chemical irritants.

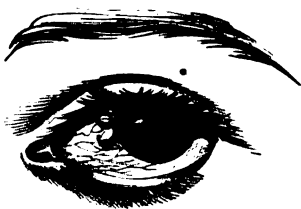
Treatment.—In the treatment of this, as of other forms of ophthalmia, it is important to keep in view some rules which are universally applicable in all inflammatory affections of this organ, namely, to remove the exciting cause if still in operation, to guard against all new causes of irritation, either to the eye itself or to the system at large, to obviate if possible the predisposing cause, which may be derangement of the functions of an organ remote from the eye, to exclude the light and to give absolute rest, not only to the affected eye but also to the other. In many cases of simple conjunctivitis, attention to these rules is alone sufficient to produce the desired effect; in other cases, it is requisite in addition to this to prescribe sometimes rest of body, low diet, aperient medicine, and cold applications over the eyelids, and sometimes local depletion followed by warm applications. Local depletion may be instituted either by leeches,—which should be applied, not to the eyelids, but around the eye, to the temple, the forehead, or the nose,—or by scarification of the conjunctiva of the eyelids, the efficacy of which in acute cases is often very speedily perceptible. The above treatment must not be too long continued, lest relaxation be induced; nor is it suitable in those cases which from the commencement partake of a chronic character, and in which passive congestion constitutes the principal condition of parts.

When acute symptoms have been subdued, counter-irritation to the temple or behind the ear, and the cautious use of some slightly stimulating lotion, together with constitutional remedies, constitute the proper treatment.

II. PUSTULAR CONJUNCTIVITIS.

Synonyms and Symptoms.—This affection,—sometimes called conjunctivitis pustulosa, ophthalmia pustulosa, and ophthalmia phlyctænodes,—commences with pain, usually very slight, but varying in degree in different cases, and attended with an uneasy sensation as if caused by an extraneous substance, and felt principally during the movements of the palpebræ. Intolerance of light is not usually a symptom of this variety. There is often a secretion which coagulates and causes the lashes to adhere together. The palpebral division of the conjunctiva is more red than is natural; on the ocular portion there is increased vascularity at some part, and sometimes one plexus of vessels appearing, sometimes several, each having its base towards the orbit and its apex towards the cornea. Lymph is deposited, and in the lymph pus is formed constituting a pustule, the most frequent site of which is over the junction of the cornea

Fig. 256.



with the sclerotic coat. In many cases there is a deposit of lymph and

serum, so that the affection presents the character of a vesicle instead of a pustule.

Pustular conjunctivitis is chiefly met with in children and young persons, and more especially in those who are of a scrofulous diathesis and liable to derangement of the function of the skin, or of the digestive organs.

Treatment.—When the disease is very acute, in addition to rest of the eye, restriction of diet, and purgation, local depletion is necessary; but in the great majority of cases the observance of the general rules of treatment already laid down, together with the application of some stimulating or astringent lotion, will be found sufficient. Of the many applications of this nature the solution of the nitrate of silver, of the strength of from two to four grains to an ounce of water, answers as well as could be desired.

III. CATARRHAL CONJUNCTIVITIS.

Causes.—This disease is most frequently caused by atmospheric changes, and hence it is usually epidemic. Exposure to damp, to cold, or to night air, especially after being heated or while in a state of fatigue, as also the circumstance of the feet or extremities being cold and wet, are all known to be exciting causes of this most common of all the varieties of ophthalmia.

Symptoms.—In addition to the usual local symptoms of catarrh, and in many cases the general symptoms of catarrhal fever, though there is frequently but little constitutional disturbance, the patient is affected with stiffness and heaviness in the palpebræ, reticular redness commencing on the palpebral portion of the conjunctiva, sandy pain, as it has been called, great lachrymation, adhesion of the eyelids in the morning, and a discharge of opaque viscid mucus which collects on the cilia during sleep, with aggravation of all the symptoms in the evening. In some though comparatively few instances, chemosis takes place to a considerable degree; and in these circumstances there is ground for anxiety as to the condition of the cornea, as it may become the subject of ulceration, or its vitality may be endangered, partly by purulent infiltration between its lamellæ in consequence of inflammation, and partly by mechanical pressure produced by great distension of the conjunctiva impeding the circulation.

Treatment.—The constitutional treatment varies according to the state of the symptoms affecting the general system; but in all cases the condition of the bowels and skin must be attended to, and a proper performance of the functions of those organs promoted. The chief part, however, of the treatment is local and of a stimulating nature; and under such the disease in most cases very soon subsides. The treatment I have usually employed, and with most satisfactory results, is that recommended by Mackenzie, namely, scarification of the conjunctival lining of the palpebræ, when the chemosis is great and the discharge distinctly purulent; the application of a few drops of the solution of the nitrate of silver twice a day; fomenting the eyelids several times a day with a collyrium composed of one grain of corrosive sublimate, six grains of muriate of ammonia, two drachms of vinum opii, and

eight ounces of water, used slightly warmed, a few drops being put into the eye in mild cases, but injected over the eye in severe cases; anointing the margins of the eyelids every night at bedtime with a very small portion of an ointment composed of six grains of the red precipitate levigated to an impalpable powder and half an ounce of butter, for preventing the tendency to adhesion of the eyelids; keeping the patient in a dark room, avoiding all cold applications, and in the chronic stage, when very obstinate, using slight counter-irritation. This last is, however, required in comparatively few cases, as the symptoms generally yield very readily to the use of the other remedies.

IV. PURULENT OPHTHALMIA.

Ophthalmia purulenta is the name given to a violent form of inflammation of the conjunctiva attended with a secretion of pus. It will enable us to describe more clearly this very distressing affection, if we treat separately of three different forms of it, namely,

Purulent ophthalmia in adults,

Purulent ophthalmia in newborn infants,

Gonorrhœal ophthalmia.

PURULENT OPHTHALMIA IN ADULTS.

Symptoms.—One of the earliest symptoms is an itching sensation, owing, it is believed, to suppression of the mucous secretion,—a symptom which is well known to be one of the earliest effects of inflammation in a mucous membrane. Another early symptom is a painful feeling as if particles of sand or glass were lodged between the eyelids and the eyeball. This feeling, which is often very severe, comes on very suddenly, and arises not from the presence of any extraneous matter, but from the dilated state of the conjunctival vessels.

There is at an early stage considerable mucous secretion from the internal surface of each eyelid. This soon becomes opaque, and then, very rapidly, purulent; and when the eyelids are separated, it runs down the cheek, producing in many instances irritation and excoriation. In this variety of the disease there soon occurs very acute and continued pain, attended with a most distressing sense of fulness and tension; there is also a sense of weight and stiffness, with great swelling of the palpebræ; and the cilia adhere to each other, in consequence of the coagulation of viscid mucus upon them. The palpebral portion of conjunctiva is first affected,—it becomes exceedingly red and swollen; great effusion takes place into its substance, as well as into the submucous cellular tissue and the other textures of the palpebræ, so that they rapidly become very much swollen and of a livid appearance, and are apt to become everted. The eyelids have at first a slight tendency to become inverted, but the great swelling and protrusion of the conjunctiva, which is forced out between the eyeball and the margin of the palpebræ, soon produce a tendency to eversion. At an advanced stage of the disease, the conjunctival covering of the palpebræ often assumes a kind of granular appearance, arising from the enlargement of the natural papillæ. The ocular portion of the conjunctiva becomes exceedingly red and swollen, effusion taking place to a great extent into its substance, and also underneath

it into the submucous cellular tissue, raising the conjunctiva considerably around the circumference of the cornea, and constituting the condition technically called *Chemosis*. The cornea becomes hazy, and afterwards opaque and dull in appearance; and if the symptoms are not subdued, the haziness greatly increases, and the cornea soon loses its vitality and is wholly or partially destroyed, in consequence of its nutritious fluid being interrupted by the tension of the conjunctiva and the rapid deposit into the submucous cellular tissue. The patient suffers much from circumorbital pain, as well as from the pain and other symptoms already mentioned as affecting the eyeball and eyelid. The constitutional symptoms are at first those of inflammatory and afterwards those of irritative fever; and their intensity is proportionate to the severity of the local disease.

Causes.—There is little doubt that in some cases, even in this country, this very serious disease originates in atmospheric influence; but fortunately it is of comparatively rare occurrence, and of the cases that do occur, a small number only are produced by this cause. It is well known, however, that in some parts of the world, as in Egypt, a very alarming form of this disease has long prevailed at different periods, owing its origin to atmospheric influence. When the disease once takes place, it is very apt to be propagated by contagion; and there is reason to believe that in confined and crowded houses, in certain situations, the disease may also be conveyed from one person to another, without the actual contact of matter with the eye, but by infection. In this country the majority of cases of purulent ophthalmia in the adult are produced by the contact of matter from the urethra, vagina, or an eye affected with the disease.

Treatment.—The treatment of this highly dangerous disease must be exceedingly prompt, and proportioned in degree to the age and strength of the patient and the intensity of the disease. The constitutional treatment in the early stage consists in the employment of venesection, low diet, perfect rest, purgative medicines—sulphate of magnesia with tartar emetic being found exceedingly useful—together with calomel and opium until the system be slightly affected. The patient should be kept in a cool, dark, and well-ventilated apartment. The local treatment most useful in the early stage consists in local depletion by means of leeches around the orbit, but not to the eyelids; depletion by scarification of the palpebral portion, and also by horizontal incisions in the ocular portion of the conjunctiva, the eyelids being kept separate to promote the depletion; diligent fomentation of the eyelids; great attention to cleanliness, and the frequent and effectual cleaning of the eyes. For this purpose a fluid must be sent between the eyelids and eyeball, by means of a small syringe, so as completely to clear away the matter, which collects very rapidly. A mild astringent should also be used two or three times a day: one of the most valuable remedies of this class is, the solution of the nitrate of silver in the proportion of three or four grains of the nitrate to an ounce of water, which generally has in a short time a decided effect in diminishing the discharge. In the more chronic stage of the disease counter-irritation is very serviceable; and more powerful astringents are often required, such

as a strong nitrate of silver ointment, or the solid nitrate of silver, applied with a pencil to the inside of the eyelids; or when the discharge has ceased, and the object is to apply an astringent to the relaxed conjunctiva, a few drops of the *vinum opii* are used with advantage.

PURULENT OPHTHALMIA IN NEWBORN INFANTS.

Causes.—Ophthalmia neonatorum, or the purulent ophthalmia of infants, is in the great majority of cases caused by the contact of leucorrhœal, or in some instances of gonorrhœal, secretion with the conjunctiva, during the passage of the infant through the vagina, and want of attention to the careful washing of the infant's eyes immediately after parturition. Sometimes, however, the disease is catarrhal, arising from the injudicious exposure of the child to cold air; or it may be caused by the soap with which the child is washed entering the eyes; or by the exposure of the eyes to a bright light.

Symptoms.—This disease usually begins to show itself on the third day after birth, at which time the ciliary margins of the palpebræ are observed to be of a pinkish red colour and glued together by a concrete puriform secretion; and if they be gently separated from each other, a little white matter escapes, and the conjunctival covering of the eyelids is extremely red, vascular, and swollen. The palpebral portion of the conjunctiva is first affected, the ocular portion soon becomes involved, effusion takes place into the subjacent cellular tissue, and chemosis is produced; the palpebræ become much swollen, tense, and of a livid red appearance; and the palpebral conjunctiva exceedingly tumefied, so that when the eyelids are separated, it is apt to project and cause eversion of the eyelids; the discharge becomes very great and of a yellow colour; if the disease be not checked, there is great danger of the cornea being either partially or totally destroyed, particularly when the chemosis is considerable, as this produces obstruction of circulation; purulent matter is infiltrated between the lamellæ of the cornea; and the lamellæ exterior to the pus giving way, the destruction spreads by ulceration.

Treatment.—The treatment I have always adopted in this form of ophthalmia is recommended by Mr. M'Kenzie, namely, washing the eyes three or four times in the twenty-four hours with a tepid solution of one grain of corrosive sublimate with six of sal ammoniac in eight ounces of water; applying once or twice a day a few drops of a solution of the nitrate of silver in the proportion of four grains to an ounce of water; applying also to the edges of the eyelids at night, in order to prevent their adhesion, a small portion of the red precipitate ointment, prepared, as recommended by Mr. M'Kenzie, by mixing six grains of the red precipitate carefully levigated into an impalpable powder with half an ounce of butter, the ointment being melted before being applied; a small dose of calomel daily, from a quarter to half a grain; occasional doses of castor oil, and slight counter-irritation behind the ears.

GONORRHOEAL OPHTHALMIA.

There are no symptoms by which it is possible with absolute certainty to distinguish gonorrhoeal ophthalmia from purulent ophthalmia produced by atmospheric influence and other causes. The history of the case will afford ground for diagnosis; and if there be very profuse discharge, if the eyelids be exceedingly swollen and livid, with much pain, and if one eye be severely affected and the other remain uninjured, there will be reason to conclude that the disease is gonorrhoeal ophthalmia. In the other forms of purulent ophthalmia it is the rarest thing possible for one eye only to be affected, and in them the palpebral portion of conjunctiva is the first attacked; but in this form the ocular portion is first affected, the disease extending itself very rapidly to the palpebral division, and it is seldom that both the eyes are involved. This disease is extremely rapid in its progress: the danger of loss of vision from destruction of the cornea is very great; and the symptoms must be promptly combatted by the treatment already recommended for purulent ophthalmia in the adult.

V. STRUMOUS CONJUNCTIVITIS.

This form of conjunctivitis is also called phlyctænular ophthalmia, ophthalmia scrofulosa, and conjunctivitis scrofulosa, from the circumstance of its being induced by the peculiarity of constitution denominated strumous, or scrofulous; and like many other scrofulous affections it is most frequently met with in children, and in persons under the age of puberty.

Symptoms.—This affection is indicated by the symptoms of the ordinary varieties of conjunctivitis accompanied with the following peculiarities, namely, that the lachrymation is great, and the intolerance of light or photophobia quite disproportioned to the local signs of inflammation.

“From the intolerance of light the patient subject to this disease avoids the light as much as possible; and children usually lie upon the stomach and bury the face in the pillow, or endeavour to exclude the light more effectually by the aid of the handkerchief or the hands, which they press closely on the affected organs. When exposed to the light for the purpose of examination, the head is immediately shrunk upon the chest; but if the hands be withdrawn, the palpebræ are found closely compressed together, and they are corrugated by violent, and sometimes spasmodic action of the orbicular muscles. It is not unusual, further, to find the face distorted by the action of the other superficial muscles of this region, not connected with the eye. If the disease has been of long standing, the surfaces of the eyelids, and of the cheeks are frequently red and excoriated from the irritation of scalding secretion and pressure of the hands of the patient.”

The ocular and palpebral portions of the conjunctiva present numerous distended vessels, and the appearances usual to the common varieties of conjunctivitis; but at the same time the local appearances bear no proportion to the excessive morbid sensibility of the eye to the light.

The inflammation is very apt to give rise to pustules on the circumference of the cornea or near it, and also to ulceration of the cornea.

Treatment.—This affection is always attended with derangement of some important function, most frequently of that of the skin or the digestive organs, and a principal part of the treatment consists in the employment of judicious means for promoting the proper performance of the functions generally, as well as the use of such means as in the particular circumstances of the case may be suitable for scrofulous cachexy. Quinine is an invaluable remedy in this disease. The local treatment which has been found most useful is, slight counter-irritation behind the ear, preceded, if the action of the disease be very acute, by slight local depletion by leeches or scarification at a very early period; the application of belladonna to the temple every night; putting a few drops of a weak solution of nitrate of silver into the eyes once or twice a day; keeping the patient in a dark room, and preventing him from keeping up the heat and irritation of the eyes by pressing them with the hand, or by lying on the face; and paying great attention to cleaning the eyes.

AFFECTIONS OF THE CORNEA.

SCROFULOUS CORNEITIS.

Causes.—This affection appears to arise in many instances from exposure to cold and wet; in some cases from want of sleep; in others from over-exertion of the eyes; and sometimes it cannot be traced to any particular exciting cause.

Symptoms.—It is principally found in persons of scrofulous diathesis, from eight to eighteen years of age, and is marked by the following symptoms:—a haziness, and in many cases an opacity of the cornea; roughness, with more or less of a thickened and changed state of its epidermis; redness on the surface of the cornea, presenting several varieties as to appearance, but in some instances so extensive as to have been compared to red cloth, and to have received the name of *pannus*; slight sclerotic redness of a dull character, constituted by the dilation of small vessels, and having no white ring such as exists between the zonular redness, and the circumference of the cornea in the inflammations of the deeper tissues of the eye. In cases of considerable standing the cornea becomes unusually convex, and sometimes even conical, with *hydrophthalmia*, or a superabundance of aqueous humour. There is considerable lachrymation, especially on exposure of the eye to light. The globe of the eye is somewhat tender, and there is a slight degree of dull pain; these two symptoms are usually of an intermittent character, and in some instances they are severe and distressingly aggravated at night; in the great majority of cases, however, there is little or no pain, except at the commencement of the affection. Another peculiarity distinguishing this disease from scrofulous conjunctivitis is, that whereas in the latter the intolerance of light is so excessive as to have been called photophobia, in this disease it is not usually felt to any great degree, though in some instances, especially where there is much redness, it is more painful. Patients have in many instances a sensation as if a

foreign substance were placed on the conjunctiva. When the disease is severe, the vision is greatly obscured, so that sometimes objects cannot be perceived, and the patient is only able to distinguish light from darkness; when it is of a milder character, there is but slight dimness, and objects are seen as through a very thin mist. The disease is slow in its progress, and is usually very obstinate: it is generally attended with other symptoms of scrofula and weakness of constitution, and with functional derangement of the skin or of some other part of the system.

Parts chiefly affected.—The superficial parts, the epidermic covering of the cornea, and the parts immediately below it are chiefly involved, and opacity results from effusion of lymph; but pustules in the first instance, and afterwards ulcers, are often formed, and although the disease is generally seated in the superficial parts, it may affect the whole substance of the cornea, and extend to the iris, the sclerotic and choroid coats, and even to the retina itself.

Treatment.—In this, as in every other form of scrofulous inflammation, the constitutional treatment is of the greatest possible importance, the principal points aimed at being to correct the functional derangement, to improve the general health, and to arrest the deposit of fibrin, by which the opacity is produced. These important indications the surgeon must endeavour to fulfil by such means as may be judicious and efficient in the particular circumstances of each individual case; but as a general rule, the most valuable means are, good diet, pure air, quinine, and the careful use of mercury, carried only so far as very slightly to affect the system. That the two medicines, carefully and judiciously employed, are invaluable in the treatment of this disease, will be readily acknowledged by all who have tried them. The local treatment consists in the employment of depletion by leeches, when the symptoms are acute; slight counter-irritation behind the ear, or on the back of the neck; warm, and especially opiate fomentations; smearing the parts round the eye with the extract of belladonna at bed-time; and when the symptoms have become chronic, the daily application to the eye of a stimulant, such as the vinum opii. The vinum opii and red precipitate ointment are the most useful stimulants, but the former is in most instances much to be preferred. Local treatment, however, will be of little avail without the constitutional treatment proper for the scrofulous diathesis.

ACUTE CORNEITIS.

Causes.—This disease sometimes comes on without any obvious cause; sometimes it arises from direct injury, or from exposure to damp and cold; and sometimes it is a consequence of inflammation of other textures of the eye.

Symptoms.—The principal symptoms are, haziness, or cloudiness, or opacity of the cornea; lachrymation; intolerance of light; pain and tenderness in the eye, liable to exacerbations, especially at night; pain throughout the orbit; redness of the cornea, evidently owing to an innumerable quantity of vessels. When the inflammation is not confined to the substance of the cornea, but affects also its conjunctival covering, a red zone may be seen, called by some the inner zone, placed over the

circumference of the cornea, and obviously formed of a number of dilated vessels proceeding from the conjunctival covering of the cornea, and penetrating the substance of the cornea itself. There is in some cases another red zone, called by some the outer zone, of a crescent shape, corresponding to a part of the circumference of the cornea, having one aspect well defined, namely, that towards the sclerotic coat, but the other not distinct in consequence of its being lost in the inner zone. This outer zone is constituted by the vessels of the conjunctiva covering the part of the sclerotic coat where it overlaps the circumference of the cornea, as well as by some of the vessels within the substance of this portion of the sclerotic coat. A point of great importance for diagnosis is to remember, that there is no intervening white ring between this red appearance and the circumference of the cornea, as there is in inflammation of some of the deeper textures of the eye.

The local symptoms, as the disease advances, vary according to the results of the inflammation. Of these some have been already explained, and others will be mentioned in the description of the remaining affections of the eye.

Treatment.—The principal remedies are, mercury, antimonials, and other antiphlogistic measures, which ought to be promptly resorted to, and continued with energy proportioned to the urgency of the symptoms and the other circumstances of the case; local depletion; warm and opiate fomentations; and, when the affection has become chronic, counter-irritation, and the very careful application of stimulants. The treatment of some of the results of acute corneitis will afterwards be mentioned.

OPACITIES OF THE CORNEA.

Opacities of the cornea differ from each other in the degree of density and opacity, in the situation, and in the mode of formation; and the terms, nebula, albugo, and leucoma are used to distinguish the different varieties from each other.

Nebula is the term used to denote the least degree of opacity, and includes only those cases in which the cornea is cloudy or hazy. Its symptoms are a cloudy appearance and an impaired state of vision. The opacity is insensibly lost in the surrounding portions, and its edges are consequently undefined.

The term *nebula* is by some authors made to comprehend slight opacity of the cornea from deposition between the laminæ of the cornea, or from deposition between it and its lining membrane, or between it and its conjunctival covering, as well as from changes in the conjunctival covering itself. It is here used in the sense in which it is employed by many, to denote the least degree of opacity depending on slight interstitial change in the conjunctival covering itself, or on very slight deposit between it and the cornea. This condition may result from slight inflammation, either originating in the part or spreading to it from other textures; and the inflammation may be excited by any of the usual causes of ophthalmia; or it may be brought on and kept up by a granular condition of the palpebral portion of conjunctiva, or by inverted palpebræ, or by inverted eye-lashes. These last-mentioned conditions are frequent

causes of nebulae; and the state of these parts should therefore be carefully observed, because if any such exciting causes be allowed to remain, no treatment will avail to remove the opacity.

Albugo is the name given to opacity of the cornea, when it depends upon the effusion of lymph into any part of the cornea or between it and its conjunctival covering, or when the effusion is so dense as to give it a white pearly appearance. The opacity is greatest at the centre. Inflammation of the cornea in any of its most common forms is apt to lead to albugo; but phlyctenular pustule, and onyx, or abscess of the cornea, are very common sources of this affection, of which partial or complete obstruction of proper vision, and a pearly white opacity, are symptoms.

Leucoma is the name given to a third variety of opacity, which depends on an opaque dense cicatrix. If the continuity of a portion of the surface of the cornea be interrupted by ulceration, sloughing, or by a wound of considerable breadth, leucoma is constituted by the corneal cicatrix by which the part is healed. Leucoma is usually depressed in the centre, and presents a contracted and circumscribed appearance. By these peculiarities it is distinguished from albugo, and by its pearly white colour from nebula. When the leucoma is large and in the centre of the cornea, loss of vision is the result.

Treatment.—The treatment of nebula and albugo is precisely the same, and consists in the removal of any exciting causes of inflammation, the subduing of the inflammatory action by the treatment formerly described, and when this has been effected, in the use of stimulants for the purpose of promoting absorption. The application chiefly employed for this end are, the solution of the nitrate of silver, the red precipitate ointment, the vinum opii, and a solution of corrosive sublimate in the proportion of a grain to an ounce of water. It is important to select the proper time for commencing the use of these stimulants, which is not until the inflammatory action has been subdued, but soon after, because up to a certain period there is a tendency to a partial absorption of the deposits, which tendency seems to wear off in course of time.

There is much less prospect of benefit from treatment in albugo than in nebula; and in leucoma, properly so called, when of some standing, none whatever. But when opacity of the nature of nebula or albugo exists around a recent leucoma; that is when slight deposit of lymph constituting nebula, or more dense and white deposit constituting albugo, surrounds the corneal cicatrix which forms the leucoma, the nebulous or albugineous opacity may improve under treatment, while the leucoma remains unchanged.

ULCERS OF THE CORNEA.

Corneitis, however induced, whether by inflammation originating in the cornea from any of the ordinary causes of corneitis, or from a foreign substance imbedded in the cornea, or by inflammation spreading from the conjunctiva or some other tissue of the eye, may give rise to ulcers of the cornea. These ulcers are divided into two grand classes, the one

comprising those which at their commencement are comparatively superficial, and the other, those which extending deeper penetrate the whole thickness of the cornea. The difference between the two classes arises from the mode in which the ulcers originate, and the form of the inflammation from which they result.

Ulcers belonging to the first class, namely, those which do not penetrate the whole thickness of the cornea, may, like ulcers in other parts of the body, exist in different states.

First.—It may be in the state of a *simple healthy ulcer*. If so, the pain is comparatively slight: the edges are not abrupt, but regular, and bevelled off; and the surface and circumference exhibit a nebulous appearance, or slight opacity, from the necessary effusion of lymph upon and around the ulcer.

Second.—It may be in the state of an *inflamed ulcer*; in this case the pain, lachrymation, and intolerance of light are great; the edges and surface are irregular; the part has an extremely irritable appearance, and red vessels are observable on the ulcer and surrounding parts, with other marks of inflammation.

Third.—It may be in the state of an *irritable ulcer*. There is in this case an entire absence of the ordinary characters of a healing ulcer; the pain is intense; the lachrymation great; and the intolerance of light excessive; the parts have an extremely irritable and inflamed appearance, but the pain and sensibility are disproportionate to the local symptoms of inflammation, more especially if the proper means for diminishing the pain and promoting the healing of the ulcer be not adopted.

Fourth.—It may assume the character of an *indolent ulcer*, exhibiting no nebulous appearance on the surface, no opacity around the edges, nor indeed any appearance of the necessary effusion of lymph; but, on the contrary, presenting a cavity comparatively clear and transparent, as if a part of the cornea had been taken out, with very little appearance of vessels, attended with comparatively little pain.

Fifth.—It may belong to the class of *sloughing ulcers*, if there be very severe accompanying ophthalmia, giving rise to great effusion and pressure on the surrounding parts. In this case the risk of sloughing is very great.

Treatment.—If the ulcer belong to the first of these varieties, that is, if it be a simple healthy ulcer, all that is necessary is, to take precautionary measures that the healing process be not interrupted: these consist principally in the regulation of the bowels and diet, and the protection of the eye from exposure to light or to any other irritating influence. If the ulcer belong to the second, third, or fourth variety, the indication is to convert it into a simple healthy ulcer; and the means usually employed for this purpose are,—if it be an inflamed ulcer, to subdue the inflammation by the local and general treatment proper for the ophthalmia of which the ulcer is a result;—if it be an irritable ulcer, to touch it every second, third, or fourth day, or as soon as the pain returns, with a solution of the nitrate of silver, which diminishes the pain in a most remarkable manner; partly perhaps by forming a slight film on the surface, and partly by destroying the sensitive filaments of the nerves

of the part;—and if it be an indolent ulcer, to employ some of the stimulating local applications in common use, together with suitable constitutional treatment.

In the case of a sloughing ulcer, the grand indication is to subdue the ophthalmia by which the ulcer is produced; and indeed this must in all cases be attended to, otherwise little benefit will accrue from any treatment instituted for the healing of the ulcer. If the ulcer be of some standing, counter-irritation is generally very useful; suitable treatment must be employed for the condition of the general system attending the ophthalmia which gives rise to the ulcer; the eyes must be kept at rest and protected from exposure to light or to any other source of irritation; and belladonna should be applied to the temple and around the eye at night, more especially if the ulcer be deep, as a means of diminishing the risk of protrusion of the iris, should penetration of the cornea take place. In every instance healing should be attempted as speedily as possible, lest the ulcer should become one of the second class, which comprehends all cases where penetration takes place through the entire thickness of the cornea.

When an ulcer belongs to this class, the following are some of the inconveniences and dangers which result.

HERNIA CORNEÆ.

Hernia corneæ is constituted by the protrusion of the membrane of the aqueous humour, with or without some slight deposit of lymph; and when the perforation is not perfectly complete, a very thin lamella of the cornea is also protruded. The protruded portion presents the appearance of a small transparent vesicle, and proper proceeding in such circumstances is to cut off the small vesicle by a single cut of a pair of scissors, to touch the part with a finely-pointed bit of the nitrate of silver, to preserve the pupil dilated by the application of belladonna as a means of diminishing the risk of protrusion of the iris, and to endeavour by all judicious means to heal the ulcer.

PROLAPSE OF THE IRIS.

Another and a common result, when penetration extends through the entire thickness of the cornea, is prolapsus iridis, of which there are several varieties. When the protruded portion is small, it presents the appearance of a small black body, which from its supposed resemblance to the head of a fly, is termed *myocephalon*, from *μυια*, *musca*, and *κεφαλη*, *caput*; when it is larger and flatter, it is called *clavus*, from its resemblance to the head of a nail; and when the iris protrudes through many different openings, the condition is called *staphyloma racemosum*; the former term being derived from *σταφυλη*, *a grape*, and applied to various grape-like swellings on the front of the eye, and the latter from *racemus*, *a bunch or cluster*.

Treatment.—When the opening is very small and the protrusion to a very slight degree, replacement may be accomplished, if it be attempted very shortly after its occurrence, and before adhesions have taken place.

It is useless, however, to employ a probe; for, although the return should be effected, the withdrawal of the probe would certainly be followed by reprotrusion. The proper mode is to excite dilatation of the pupil by the very free application of belladonna to the temple and around the eye; and by this means the two desirable indications, namely, to effect replacement, and to prevent reprotrusion, are sometimes fulfilled. All judicious means should then be adopted for avoiding irritation, and for promoting the healing of the ulcer. When the opening is larger and the protrusion to a greater degree, or of some standing, it may be impossible in consequence of adhesions to effect replacement; but if it were possible, it would not be desirable, for the only means of preventing escape of the aqueous humour and consequent collapse of the eye, is by allowing the iris to remain in the wound and becoming adherent. The proper steps to be taken therefore are, to promote adhesion, to avoid irritation of the eye by exposure to light, or by friction of the eyelid on the protruded part, to apply belladonna to the temple and around the eye at night, to use the treatment suitable for any accompanying ophthalmia that may still remain, and when adhesions have taken place and cicatrization advanced, to destroy the protruded part by the slightest possible touch with a very pointed portion of the solid nitrate of silver. The local application employed in the first instance for diminishing the irritability of the ulcer and promoting adhesion, is the solution of the nitrate of silver, of the strength at first of two or three grains to the ounce, and afterwards gradually stronger, if necessary. The use of the solid nitrate of silver would be attended with considerable risk of increasing the size of the ulcer, and, therefore, the solution is preferred; but after cicatrization has taken place, it may be employed in the solid form with the view and with the precaution above mentioned.

CONICAL CORNEA.

It is a remarkable fact that this singular affection of the cornea was never mentioned by any ophthalmic surgeon before the year 1766, when John Taylor described it in his "*Nova Nosographia Ophthalmia*." The "*London Journal of Medicine*," for May, 1850, contains a very interesting original communication on conical cornea, by W. White Cooper, Esq., Senior Surgeon to the North London Eye Infirmary; from which it appears that this affection is peculiar to the human species; that it is limited to civilized races; that it prevails most in warm climates and in warm situations, and becomes more and more rare as we approach the colder latitudes; that it is rarer in Scotland than in England, and rarer in the north of England than in the south and west; that Mr. Walker, of Edinburgh, did not meet with one case out of 7679 patients, at the Edinburgh Eye Dispensary; that Dr. Cadenhead, of Aberdeen, has seen only three cases out of upwards of 8000 patients under his care in the Aberdeen Ophthalmic Institution, and in the ophthalmic wards of the Aberdeen Royal Infirmary; that Mr. Mackenzie, of Glasgow, has met with only four instances out of 15,924 cases, treated at the Glasgow Eye Infirmary; whereas, returns from

China give twenty-two examples out of 6789; from Dublin, 10 examples out of 4050; and from Plymouth, 18 out of 5118 cases.

The following is part of a table given by Mr. Cooper, to show the proportion of cases of conical cornea.

TABLE SHOWING THE PROPORTION OF CASES OF CONICAL CORNEA.

	Total Cases.	Conical Cornea.		Total Cases.	Conical Cornea.
GLASGOW EYE INFIRMARY.			Brought up . . .	42310	40
June 1824 to Jan. 1847	15924	4	1846	7010	9
ABERDEEN HOSPITAL AND EYE INFIRMARY	8000	8	1847	7672	5
EDINBURGH EYE INFIRMARY.			1848	8882	6
Jan. 1842 to Jan. 1850	7679	0		65874	60
	81608	7	PLYMOUTH EYE INFIRMARY.		
MACAO HOSPITAL.			1845	986	3
1841 to 1842 . . .	1288	7	1846	848	0
1844 to 1845 . . .	5499	15	1847	918	8
	6787	22	1848	1208	4
			1849	1213	3
ST. MARK'S HOSPITAL, Dublin.				5118	18
1845	980	2	LIVERPOOL EYE INFIRMARY.		
1846	1526	6	1834	1770	2
1847	1544	2	1835	1986	0
	4050	10	1836	1965	4
ROYAL LONDON OPHTHALMIC HOSPITAL, Moorfields.			1837	2186	0
1839	4891	2	1838	2189	0
1840	5855	10	1839	2280	0
1841	5528	5	1840	2186	0
1842	6065	7	1841	2224	2
1843	6572	0	1842	2244	2
1844	6874	12	1843	2287	1
1845	7005	4	1844	3078	3
	42310	40	1845	3462	8
			1846	3510	2
			1847	3721	0
			1848	3798	1
				38836	20

From this table it is evident that conical cornea is a very rare disease. I have seen but one case, and it was one of three occurring in the large experience of Dr. Cadenhead, who did me the favour of showing it to me; a finer example it is impossible to conceive. It appears that Von Ammon was the first to affirm that this disease is sometimes congenital, and some other observers have since arrived at the same conclusion; it seems, however, to be very rarely congenital, to be rare in children and old people, and to develop itself most frequently about the age of puberty.

Symptoms.—The cornea presents the appearance of a cone, and generally, but not invariably, the entire cornea is affected; the apex of the cone being usually at the centre, and its base at the circumference, corresponding to the junction of the cornea with the sclerotic coat. The surface of the cornea, when examined by an unassisted eye, appears smooth and even, but under a lens, as was first noticed by Sir David

Brewster, it is seen to be broken up by elevations and depressions. The perception of distant objects becomes confused, and eventually is lost ; at the same time, small objects are with difficulty distinguished at a moderate distance, and, as the disease proceeds, a nearer and nearer approximation of them to the eye is necessary, to enable the patient to distinguish them ; and, at last, they cannot be recognised at all. Before useful vision is entirely lost, patients can only perceive objects when held very close to the eye and to one side. It has been observed that

Fig. 257.



before the change in the cornea is very much marked, there is an unusual lustre and brilliancy of the eye, which, in a well-lighted room at night, has been compared to the sparkling of a diamond, and adds exceedingly to the expression of the eyes.

Causes.—The recorded experience of several authorities, namely, of Dr. Farre, Mr. Tyrrell, Mr. Square of Plymouth, and others, leaves little doubt that in some cases excessive weeping has been the exciting cause to which the disease was traceable ; and it has been remarked that congestion of the eyes combined with compression of the globes, is highly favourable to the development of the disease. From the observations of Dr. Fr. Jaeger of Vienna, of Mr. Mackenzie of Glasgow, of Dr. Jacob of Dublin, and of Mr. W. White Cooper of London, it appears that this disease, in some circumstances at least, is a result of true corneitis, more especially in persons of an enfeebled constitution with a low condition of nervous energy. The cornea being rendered opaque and enfeebled by the inflammation, yields in the course of time to the pressure of the contents of the eye, and the opacity disappears. In several cases in which opportunities have occurred of examining the state of the cornea after death, it has been found of the usual thickness at its circumference, but very much thinner at its apex, and the laminae less movable than natural. For much interesting information regarding this disease, I beg to refer the reader to Mr. Cooper's valuable communication above mentioned. •

Treatment.—If the views above stated be correct regarding the cause of this disease, the proper treatment consists, first, in the removal of the corneitis, and afterwards in endeavouring to prevent increase by the use of local stimulants, together with suitable treatment for the general health. Some ophthalmic surgeons have thought that this treatment, where it was not successful in diminishing, yet retarded the increase of the prominence. Dr. Pickford has published an account of cases in which relief was obtained by a course of purgatives and emetics. Tonics with counter-irritation, have also been used, and, some have thought, with advantage. Removal of the crystalline lens has been resorted to, with the view of diminishing the refractive power of the eye ; but although in one case, operated upon by Sir William Adam, the sight was improved, still the proceeding has not been found useful. Mr. Tyrrell has in some cases had recourse to alteration of the position of the pupil, so that it may not be opposite to the part where the cornea is most changed. He effects

this by puncturing, with a needle, the cornea near its circumference, between the outer and under aspect of the eye; he then introduces a hook through the wound, draws down the pupillary margin of the iris, and brings a small portion of it through the wound, so as to draw down the pupil; and the object then is to obtain adhesion of the iris to the wound in the cornea.

Mr. Tyrrell states his impression of the results in the following words: "The advantage gained is more than adequate to the risk incurred; for in no instance has any evil followed, beyond the slight degree of inflammation necessary to repair the mischief occasioned by the operation."

AFFECTIONS OF THE SCLEROTIC COAT.

SCLEROTITIS, OR RHEUMATIC OPHTHALMIA.

Causes.—This distressing disease is induced by atmospheric influences, as a blast of cold air; exposure to cold and damp, or the passing from a warm room into the cold air; and an attack of this form of ophthalmia seems to create a predisposition to a return of the disease. It rarely takes place either before the age of puberty or in advanced life; but occurs in adults and in persons of middle age, and most frequently though not exclusively, in those who suffer from rheumatic affections.

Symptoms.—The *pain* is of a severe, agonizing, dull, pulsative character, affecting not only the eye, but the temple and all the parts around the orbit, constituting what is called the circumorbital pain. It is attended with a most distressing sense of fulness in the eyeball and tenderness on pressure, and has this distinguishing peculiarity, that although unceasing it is greatly aggravated during the night. There is *redness*, which on examination is found to be of a dull character, and formed of small vessels under the conjunctiva, not obedient to the movements of the conjunctiva; and instead of being reticulated as in conjunctivitis, it is *radiated* or *zonular*. There is haziness of the cornea and dimness of vision; and the movements of the pupil are sluggish. There is no lachrymation; on the contrary, patients complain of a feeling of *stiffness* and *dryness*; there is little intolerance of light, and the pupil is but very slightly contracted. The disease is

Fig. 258.



often conjoined with inflammation of the conjunctiva, constituting catarrho-rheumatic ophthalmia; and in this case there is profuse lachrymation, great intolerance of light, and the sandy pain. Occasionally it is attended with some degree of iritis, and in this state also there is intolerance of light, and the pupil is generally more contracted. A considerable degree of irritative fever usually accompanies this disease.

Seat of the Disease.—The inflammation has its seat in the sclerotic coat and in the tunica albuginea; but frequently other textures, such as the conjunctiva and iris, become also involved.

Treatment.—In this disease constitutional as well as local treatment is necessary; the former consisting, especially in severe cases, or where there is constitutional disturbance, in the employment of general blood-

letting, purgatives, antimonials, low diet; and calomel and opium at bedtime; the latter, in the use of local depletion by leeches, warm fomentations, blister to the back of the neck, or behind the ear, and the application of belladonna to the temple and around the eye at night.

CATAKHO-RHEUMATIC OPHTHALMIA.

Causes.—The causes of this very dangerous and common compound form of ophthalmia are the same as those of Scleritis, namely, atmospheric influences,

Seat of the Disease.—Both the sclerotic coat and the conjunctiva are involved, and are usually attacked simultaneously; hence the disease is said to be a compound of scleritis and conjunctivitis. It very frequently extends also to the cornea and iris, producing results by which vision is in many cases greatly impaired, and in some instances entirely lost.

Symptoms.—In this disease the patient has, as in cases of conjunctivitis, the sandy pain (as it is called), or the feeling of sand between the eyeball and eyelids; reticular redness, constituted by vessels movable on moving the conjunctiva; lachrymation; discharge of mucus, very rarely of pus; adhesion of the eyelids in the morning; intolerance of light; swelling of the palpebræ, and sometimes chemosis; and, as in cases of scleritis, the agonizing circumorbital pain, and pain in the eyeball; a feeling that the eyeball is too large for the orbit; the radiated or zonular redness, deep-seated, and formed by vessels which are not obedient to the movements given to the conjunctiva; a feeling of stiffness and tenderness on pressure; and violent irritative fever. If there be chemosis, it may be impossible to perceive the radiated or zonular redness. The pain proceeding from the sclerotic coat, although unceasing, is greatly increased during the night; the sandy pain is, on the other hand, greatest in the morning. The cornea is exceedingly apt to be involved, becoming the subject of ulceration, or of onyx or effusion of pus between its lamellæ—a very alarming condition, as the pus of an onyx in this form of ophthalmia is very rarely absorbed. The iris also is very frequently involved; its colour changing, the motions of the pupil becoming sluggish, and the pupil contracted. If the disease does not subside, there is great danger of the pupil becoming obliterated. Such are some of the distressing results in unfavourable cases of this disease.

Treatment.—In addition to the treatment for scleritis already described, it is necessary, on account of the affection of the conjunctiva, to resort to the remedies proper for conjunctival inflammation, namely, scarification of the conjunctiva over the sclerotic coat—and the greater the chemosis, the greater is the necessity for this proceeding—the use of the solution of the nitrate of silver, and touching the margins of the eyelids at bedtime with the ointment of red precipitate, prepared as formerly directed.

CHOROIDITIS.

Choroiditis, or inflammation of the choroid coat, may exist as a primary and distinct disease, and occurs in adults, and most frequently in

females of a scrofulous constitution. This disease is one of the most dangerous forms of ophthalmia; and the symptoms at first are by no means of a very urgent or striking character.

Symptoms.—An important symptom of this disease is alteration of the colour of the white of the eye, the alteration being usually proportioned to the severity and advancement of the disease; the white of the eye is changed to a bluish or purplish hue, produced by the choroid coat, shining through the attenuated parts in front of it. There is redness which presents the peculiarities of not being perceptible over the whole of the white of the eye, but confined to one aspect, and of having the appearance of being formed by a broad set of vessels branching out towards the conjunction of the sclerotic coat and the cornea. In the course of time protrusion takes place at the discoloured part. The cornea usually becomes slightly opaque, but the opacity is generally confined to the aspect towards the protrusion. Displacement of the pupil is a remarkable symptom: and in some cases it occurs to such a degree as to bring the pupil nearly behind the corneal conjunction. Pain, in the early stage, is sometimes very slight, but when the distension and swelling of the eye become considerable, it is perfectly agonising in the eye, and, in most cases, over the side of the head also, constituting what is called hemicrania. There is intolerance of light and epiphora.

Fig. 259.



The vision is very differently affected in different cases: in many instances it is impaired by dimness, before any other symptom is perceptible; in some it is soon entirely lost; and in others, it remains to a considerable degree for some time after the eyeball has become enlarged and its colour altered. The appearance of flashes or sparks of light called photopsia (from $\phi\omega\varsigma$, *lux*, and $\sigma\pi\tau\alpha\iota$, *video*), and that partial defect of vision called hemiopsia (from $\eta\mu\iota\varsigma$, *semis*, and $\sigma\pi\tau\alpha\iota$), the peculiarity of which is, that only half or part of an object can be distinguished at a time, are both often early symptoms.

Treatment.—The principal remedies are early, profuse, and in some cases repeated, general blood-letting; purgatives, which are especially serviceable; antimonials, and the vapour bath; local depletion by leeches, which, in order to be beneficial, must be very copious: counter-irritation: and when the disease has become chronic, if the distension be great, paracentesis oculi through the sclerotic and choroid coat, in order to evacuate the watery secretion underneath the latter, and between it and the retina. When the active stage is over, the use of tonics, more especially the preparations of quinine and iron, either alone or combined, is resorted to with advantage.

RETINITIS.

In the acute form of this awfully painful disease the outward appearances of inflammation are not perceptible, until other textures have become involved along with the retina.

The patient at first feels an unpleasant sensation of pressure and

tension, which is soon succeeded by most excruciating deep-seated pain. The pain is pulsating, aggravated by the recumbent posture, by the motion of the eye, or by the least motion of the body; it soon extends to the head, and becomes so great as to be almost intolerable, and sometimes to produce delirium. The vision is very early diminished, and very quickly becomes more and more impaired, until it is lost. Intolerance of light is an early symptom, which, however, usually subsides before the pupil becomes closed. The patient complains of a most distressing and annoying sensation of fiery spectra, and I have known this symptom to continue even after the pupil became entirely closed. The pupil soon loses its black appearance, and closes without undergoing any alteration in its shape or situation; but before it closes, the retina is perfectly insensible to light. The iris undergoes changes of colour, which will afterwards be mentioned. The cornea loses its shining appearance, and the inflammation of the other textures of the eye becomes perceptible. In addition to these local symptoms the patient is distressed with violent symptomatic fever.

Treatment.—Profuse, early, and if necessary, repeated general depletion, purgatives, antimonials, and the use of mercury so far as to affect the system, are the general remedies; and local depletion by leeches, rest of the eye, exclusion of light, counter-irritation and the application of belladonna, constitute the local applications; and they require to be employed with the greatest promptness and followed out very energetically; otherwise, total loss of vision is likely to be the result.

IRITIS.

Iritis, or inflammation of the iris, a very common affection, may be, as to its intensity, acute or chronic,—a distinction of great importance; as to its origin, idiopathic or traumatic: and as to its cause it may be unconnected with any constitutional affection, or it may be induced and modified by some specific taint or diathesis, especially by syphilis, scrofula, and the rheumatic and gouty diathesis. Though variously modified by these different constitutional causes, as inflammations of other textures often are, it is no doubt one and the same affection.

There is always a tendency in this disease to affect also other tissues of the eye, such as the choroid, sclerotic, or conjunctival coats, or the cornea: but notwithstanding this well-known fact, it is perfectly certain, that in many severe cases, where other textures have become involved, the iris has remained the focus of the inflammation, and after the subsidence of the disease has been found the principal seat of the morbid changes.

We shall refer in the first instance to the acute and chronic forms of common iritis, and then very briefly to the more important peculiarities of iritis when modified by a constitutional taint or diathesis.

ACUTE IRITIS.

Symptoms.—Pain in the eye is commonly one of the early symptoms. In some cases the pain is slight, in others severe; and when the inflammation extends to the sclerotic coat, the patient suffers from circumorbital pain increased greatly during the night: this, however, does not

depend on the iritis. Zonular redness around the margin of the cornea is a very characteristic symptom. It is

Fig. 260.



produced by minute, closely compacted vessels in the sclerotic coat, running in radii from the margin of the cornea towards the orbital margin, deepest in colour close to the cornea. The extent and depth of colour are proportioned to the severity of the disease. Sometimes this zonular sclerotitis, as it has been called, is separated from the circumference

of the cornea by a gray line, which in some instances encircles the whole circumference of the cornea, and in others only a part of it. The vessels of this zonular sclerotitis are not obedient to movements communicated to the conjunctiva; but when the conjunctiva becomes involved, vessels of a much larger size are observable, having a reticulated arrangement and being obedient to the movements communicated by the finger to the conjunctiva, and similar to those seen in conjunctivitis when that affection presents itself as a primary disease. Another symptom is dimness of vision increasing as the disease proceeds. For some time objects are seen as through a piece of gauze or a mist; but the dimness may continue to increase until it ends in total blindness. Numerous gray or dark muscæ are perceived, which indicate that the inflammation has extended to the choroid coat, as will be understood from what has been previously mentioned. Intolerance of light is a usual, though not an invariable, symptom, and when present is accompanied with lachrymation.

Change of appearance and discoloration of the iris are striking symptoms. The first change is, that the iris loses its brilliancy and presents a dull appearance, "absorbing the rays of light instead of reflecting them," as an excellent author has remarked. The kind of discoloration varies according to the natural colour of the iris. If the iris be naturally gray or blue, it acquires a greenish hue; if brown, hazel, or dark-coloured, it changes but little in the early stage of the disease, and afterwards acquires a reddish-brown tinge. These changes are caused by the increased vascularity and the deposition of fibrin into its substance or on its posterior surface. Other symptoms observable about the iris are, that the pupil becomes contracted, its motions sluggish and eventually perhaps entirely lost. Lymph is effused on the margin of the pupil and into the posterior chamber, and sometimes into the anterior; and there are adhesions of the iris to the capsule of the lens. The aqueous humour becomes turbid, and the cornea losing its sparkling appearance becomes cloudy and hazy. Such are the usual symptoms when the disease is confined to the iris, or when that texture is the focus of the inflammation; but when iritis is accompanied with inflammation of other textures, as the choroid, sclerotic, or conjunctival covering, or the cornea, the symptoms will be mixed up with those of inflammation of the involved tissues.

Treatment.—The principal objects aimed at by treatment are, to subdue the inflammation; to prevent the effusion of lymph, and to promote its absorption when effused; to prevent contraction of the pupil,

and to promote its dilatation when contracted; to prevent adhesions; and in many cases to subdue the pain, which is sometimes exceedingly distressing. The best means for fulfilling these indications are, early general depletion in all cases where the inflammation is severe; local depletion by means of leeches; antimonials; the use of mercury, carried to an extent to affect the system, and that as speedily as possible; this being the most valuable remedy of all not only for preventing the effusion, but also for promoting the absorption of lymph; the application of belladonna to the temples at night; counter-irritation by means of blisters behind the ear after depletion; rest of the eye; exclusion of light; rest of body, and due regulation of the diet and of the bowels. Calomel is the preparation of mercury preferred, and for the purpose of diminishing the pain, as well as for other reasons, it is used in combination with opium.

CHRONIC IRITIS.

Symptoms.—The principal symptoms are, a dull condition of the iris, slight change of colour, sluggishness in the movements, and eventually perhaps a motionless condition of the iris, with irregularity and thickening of the edges of the pupil, adhesions to the capsule of the lens, and impairment of vision. From this it is evident, that for the purpose of distinguishing iritis from other inflammatory affections, the appearance of the iris, the state of the pupil, and the condition of the iris as to motion, are important points for observation.

Treatment.—The indications of treatment are best fulfilled by the use of mercury, which, however, is given more sparingly than in acute iritis, and is often advantageously combined with tonics: and the application of belladonna round the orbit. In recent cases the benefit of giving mercury internally, together with the outward application of belladonna, is often very great; the one remedy, by dilating the pupil, keeps up tension on adhesions that may have formed, while the other weakens them by promoting absorption.

TRAUMATIC IRITIS.

Traumatic iritis may be the result of wound of the iris or of the lodgment in it of some foreign matter, such as a bit of stone, metal, or some other hard substance. This variety is always acute, and in addition to the usual symptoms of common acute iritis, there will be others varying in different cases according to the nature of the injury exciting the inflammation. The treatment, therefore, will comprehend the use of remedies suitable for both these classes of symptoms. If the irritant be very small, it should be allowed to remain, unless its removal could be very easily effected; but when it is likely to cause destruction of the tissue, it should, if possible, be removed; otherwise the remedies for subduing the inflammation will be used with little advantage.

RHEUMATIC IRITIS.

This form of iritis, which is for the most part caused by atmospheric changes, is sudden in its attack, and is characterized by changes, commencing at the edge of the pupil, and extending towards the circumference of the iris. These changes consist in alteration of colour, first

in the lesser and afterwards in the greater circumference of the iris, contraction and irregularity of the pupil, with loss of its bright black colour, a retraction, or drawing back of the margin of the pupil, and a pressing forward of the iris at its ciliary circumference as soon as discoloration, a never-failing symptom of inflammation, has reached the greater margin. The pupil presents a grayish appearance as the disease advances, owing to the effusion of slight films of lymph, by which the irregular retracted margin of the pupil is apt to become adherent to the capsule of the lens. When the iris becomes adherent at one or more points of the capsule of the lens, it constitutes the condition termed *synechia posterior*; and when the front of the iris becomes adherent to the back of the cornea, the condition is called *synechia anterior*. The pain in the eye, and the nocturnal circumorbital pain, are both distressing. There is at first great intolerance of light, but as the disease advances, the vision becomes so much impaired, that in some instances patients cannot do more than discern the light. The iris in some examples becomes irregular on its anterior surface from deposits, not only into its substance, but also on the surface. The deposits of lymph in the last-named situation sometimes present small eminences, the effusion being under the membrane of the aqueous humour, but in some cases, from the giving way of that membrane, the effusion is into the anterior chamber, constituting *hypopion*. Owing to deposits within and upon the iris, its natural brilliancy is lost. The presence of the above symptoms with those of common iritis, and accompanied with the rheumatic diathesis, will enable the surgeon to form a correct diagnosis.

The same remedies are employed as in common acute iritis; and it may here be added, that the greatest caution is necessary after the use of mercury, as it greatly increases the susceptibility of the system to be affected by exciting causes of the disease: that the eye and head must be carefully guarded against changes of temperature during treatment; that blisters to the back of the neck are particularly useful in this form of iritis, and that quinine is often extremely beneficial, especially in scrofulous persons, and often also in others after depletion and the use of mercury. It is of the greatest possible importance for the cure of the local affection to institute treatment proper for the constitutional diathesis.

ARTHRITIC IRITIS.

Arthritic iritis, or gouty inflammation of the iris, is met with in persons who have suffered from gout, especially if they have been distressed with dyspepsia or depression of body or mind, or have an enfeebled condition of the general system. In such persons this may be the primary and only affection of the eye, or it may be the form into which a common variety of ophthalmia degenerates. But in persons of hereditary predisposition to gout, who have been troubled with symptoms of gastric or renal derangement, and whose constitutions are enfeebled by intemperance and other causes, it is believed that arthritic iritis may present itself as a primary disease before any joint has been affected with gout.

This variety exhibits the general symptoms of iritis, but is charac-

terized by a loaded state of the vessels of the conjunctiva : by a line of a bluish white colour at the edge of the cornea ; by the zonular redness being of a purplish hue ; and by the pain being of a severe racking character, greatly increased at night, with remissions but not intermissions during the day. These local peculiarities, the fact that the disease comes on without any known exciting cause, the peculiar tinge of the zonular redness, the history of the patient, and the state of his general health, will all assist in forming a diagnosis ; but as some of these local appearances are met with in old persons in common inflammation excited by cold, the surgeon should satisfy himself as to the existence of an hereditary predisposition to gout, before giving a decided opinion.

General bleeding and the free use of mercury, are not employed as the usual modes of treatment in this form of iritis, although cases sometimes occur with a full pulse and a dry state of skin, in which bleeding is practised with advantage. These cases, however, certainly form the exception and not the rule ; and with regard to mercury, it is only in very severe cases that it is used, except as an alterative. And the reason of this practice, as regards both these remedies, will at once be evident when it is remembered that arthritic iritis is in general asthenic ; that it usually occurs in persons of an enfeebled state of general health, and that the local disease is not so much under the influence of pure antiphlogistic remedies as of those calculated to improve the general diathesis which originates and controls the local disease. Along with suitable means for preserving a proper condition of the secretions of the bowels and skin, local depletion, counter-irritation to the back of the neck, great attention to diet, the very free use of belladonna, local warm stupes medicated with belladonna or opium, the use of colchicum, or of colchicum with alkalies, or of iodine, or of quinine, or of combinations of these medicines, or of turpentine, and the employment of judicious means for improving the general health, are the remedies from which benefit is found to accrue.

SYPHILITIC IRITIS.

This is one of the most common varieties of specific inflammation of the eye, and, if neglected or improperly treated, it is most destructive in its results. Thus far authorities are perfectly agreed ; but they differ on the question whether in this variety the general symptoms of iritis present any peculiarities which are really diagnostic. On this subject a great authority remarks, "The fact, however, that even directly contrary appearances have been enumerated as diagnostic of syphilitic iritis, shows that to distinguish this species from the rheumatic, something more must be taken into account than any differences which may be observed in the general symptoms of the disease." As characteristic of this variety, Beer reckons displacement of the pupil, a gradual movement of it upwards and inwards, and condylomata sprouting from the iris, of a reddish brown colour, growing occasionally from the margin of the pupil, and projecting from the plane of the iris. Others consider as characteristic symptoms the very abundant effusion of lymph or pus, and its arrangement in many cases, so as to form a

brown irregular ring around the pupil, the thickened condition of the pupil, and the nodulated arrangement of the effusion on the surface of the iris : but the diagnosis is readily made out by the history of the case, and by the coexistence of other constitutional symptoms of syphilis. It is found in conjunction with papular, pustular, tubercular, and scaly eruptions, and with other constitutional symptoms, such as ulcerations of the throat, pains of the limbs, and swelling of the periosteum. The only reason that can be assigned for its occurrence is the contamination of the system by the venereal poison.

The treatment which is followed with the most beneficial results in the great majority of cases, is the administration of calomel and opium ; and when these remedies are unsuccessful—which is very rarely the case, except when the system is too weak and irritable for the use of mercury in any form or combination—then reliance is to be placed chiefly on the iodide of potassium, either alone or in combination with sarsaparilla, or quinine, along with suitable means for improving the general health ; but after what has been already stated as to the constitutional treatment of secondary and tertiary syphilis, I hope it is unnecessary to say more regarding the treatment of this variety of syphilitic disease. Turpentine taken internally has been found useful in this and in some other inflammatory affections of the iris.

SCROFULOUS IRITIS.

Strumous iritis may occur as a *primary* affection ; or it may be *secondary*, as a consequence of scrofulous inflammation of the cornea. The inflammation is very apt to extend in scrofulous corneitis to the iris, and in scrofulous iritis to the cornea. The symptoms of the scrofulous diathesis afford such ample means of forming a diagnosis, as to make it unnecessary to refer to any modifications of the general symptoms of iritis in this exceedingly common variety.

In the treatment of this, as of all other examples of scrofulous inflammation, it should be kept in view, not only that depletion is very undesirable in persons of a scrofulous diathesis, but also that scrofulous inflammation is much less susceptible of benefit by depletion than common inflammation, and that the free use of mercury is far from favourable in persons affected with this peculiarity of constitution. Cases sometimes occur of so acute a character that it is necessary to resort to local depletion and to the use of calomel and opium, so as very slightly to affect the system ; but the latter proceeding ought always to be avoided, except when it appears necessary in a very severe case in order to save the eye. The treatment generally consists in the use of gentle counter-irritation, rest of the eye, exclusion of light, the application of belladonna, alterative doses of a mild mercurial, the administration of sulphate of quinine, and in many cases of quinine in very free doses with a small dose once a day of mercury with chalk ; and the use of all judicious and practicable means under the circumstances for the improvement of the general health ; for it is always to be remembered that scrofulous inflammation is more amenable to remedies for improving the general health than to pure antiphlogistics. Cases often occur in which, along with tonics and other means for increasing the general

strength, slight local depletion is required. A difficulty presents itself in the treatment of scrofulous iritis from the circumstance that the condition of the eye renders it impossible to resort to all the means most calculated to improve the scrofulous diathesis.

CATARACT.

Definition.—The term cataract (derived from *καταρῆσθαι*, to break, vision being broken or disturbed by this disease) is used to denote opacity, situated anywhere between the vitreous humour and the pupil.

Classification.—All cataracts are divided into two grand classes, namely, the true, comprehending all those which have their seat in the lens, the capsule, or both; and the spurious, comprehending those, the situation of which is external to the capsule.

TRUE CATARACTS.

True cataracts, when classified with reference to their origin, are arranged into idiopathic, or those which originate spontaneously, and traumatic, or those which arise from injury; when with reference to their appearance, into milky, purulent, flocculent, radiated, amber, black, &c.; and when with reference to their situation, or the particular part affected, into lenticular, capsular, and capsulo-lenticular. This last arrangement is the most important one in a practical point of view; and for determining the kind of operative proceeding suitable, it is also necessary to attend to a division of lenticular cataracts based on consistence, namely, into *hard* and *soft*.

Symptoms.—The symptoms of cataract have, by an excellent authority, been arranged into the *subjective*, consisting of certain feelings experienced by the patient, and the *objective*, consisting of certain changes or conditions in the eye observed by the surgeon. The principal symptom belonging to the first class is impairment of vision: as this symptom is common to cataract, glaucoma, and amaurosis, its peculiarities in the case of cataract must for the purposes of diagnosis be minutely observed; they are the following:

At first the patient sees objects, as if a thin mist, a cloud, or piece of gauze, intervened between the object and the eye. In the earliest stage this symptom is only perceptible in a bright light; and, consequently, during this period, although vision is impeded by mistiness in mid-day light, it becomes distinct in the evening, or in a room where the light is diminished by a curtain or thin blind; and a patient in a room, having while he looks to the window a distinct perception of the cloud between the object and the eye, loses it completely, and sees objects clearly on turning his back to the window. The perception of mistiness is also removed by holding between the object and the eye a piece of stained glass, which diminishes the quantity of light. Other peculiarities are, that vision is more indistinct when objects are held directly in a line with the axis of vision than when they are looked at sideways or in a slanting manner; and that the confusion of vision is removed by the application of belladonna around the eye. In this early stage, then, the perception of mistiness is lost, and vision becomes distinct in a dull light, or when the pupil is dilated by belladonna, or when objects are looked at obliquely

or slantingly; hence patients are observed at this period to diminish the light by shading the eye with the hand, and to hold objects above or below the axis of vision when they wish to see them with distinctness. As the disease advances, however, the defect of vision increases, and the dimness is perceived in all circumstances, though to a less degree under those conditions under which it was previously imperceptible: eventually useful vision is completely lost; but the patient does not become blind so as to be unable to distinguish light from darkness, as in some of the diseases afterwards to be described.

The explanation of the above-mentioned peculiarities is the fact, that in the great majority of lenticular cataracts, opacity commences in the centre, and gradually but slowly extends to the circumference; and in the contracted state of the pupil, caused by exposure of the eye to a bright light, or when an object is looked at directly in front of the eye, the rays fall upon the opaque portion of the lens; whereas, in a dull light, or when the pupil is dilated by belladonna, or when objects are looked at obliquely, the rays falling towards the circumference of the lens are transmitted by the transparent portion, and distinct vision is the result.

In a very rare variety of lenticular cataract, opacity commences at the circumference, and in such cases vision is rendered more confused in a dull light, or by dilating the pupil. Two other points important to be kept in view for arriving at a correct diagnosis are, that objects which are seen are in no case iridescent, and that the obscurity does not vary on different days, but in similar circumstances remains constantly the same.

Such are the subjective symptoms, as they have been called, or those referable to the feelings and perceptions of the patient. The principal objective symptoms, or those observable by the surgeon, are the following:—

On examination, the pupil, instead of presenting its natural black brilliant appearance, is observed to be of a grayish or whitish colour, which, in the great majority of cases, is most distinctly seen in the centre, and imperceptibly blends with the surrounding transparent structure. As the disease advances, this opacity increases in density, and extends more towards the circumference. It can be detected with the pupil in its natural condition; but, for a thorough examination, the pupil should be dilated with belladonna. The colour and site of the opacity should be carefully observed; in lenticular cataract, the site is immediately behind the pupil, whereas in some other affections of the eye, as for example in glaucoma, it is a considerable distance behind the pupil, appearing deep in the vitreous humour. In lenticular cataract, the dark shadow of the iris may be seen presenting the appearance of a ring surrounding the opacity. These peculiarities, if the form of the opacity be neither convex nor concave, and its appearance nearly uniform, indicate that the cataract is lenticular, and, if the colour of the opacity be amber or dark gray, that the lens is hard; if it be light gray, that it is soft. If the form of the opacity be convex, the site of the cataract is the anterior portion of the capsule, and in that case it appears immediately behind the pupillary margin, and presents a dull white, never a glistening ap-

pearance. If the opacity be concave, the posterior portion of the capsule is the site of the cataract, which will then appear at a considerable distance behind the pupil, and will be further distinguished by opaque streaks radiating from the centre. The iris retains its mobility in cataract, but does not in general exhibit any of that tremulous motion which is so often found connected with congenital cataract, where it is usually met with in combination with oscillation of the eye-ball.

There is a mode of examination by the reflection of light, proposed by M. Sanson, and called the *catoptric test*, which should not be omitted, as it furnishes the means for diagnosis between cataract, glaucoma, and amaurosis. For the application of this test, the pupil should be dilated by belladonna, and the patient placed in a dark room.

"When a lighted taper is moved before the eye of a healthy person, three images of it may be observed. First, the erect image, that moves upwards when the candle is moved upwards, and that is produced by reflection from the surface of the cornea; secondly, another erect image, produced by reflection from the anterior surface of the crystalline lens, which also moves upwards when the candle moves upwards; and thirdly, a very small inverted image, that is reflected from the posterior surface of the crystalline lens, and that moves downwards when the candle is raised upwards. Now in cataract, the inverted image is from the first rendered indistinct, and soon abolished; and the deep erect one is soon afterwards abolished also." In glaucoma, the deep erect image is even more evident than in the sound eye, and it is only in the very advanced stage that the inverted image is obliterated. In amaurosis, all the images are as distinct as in the healthy eye.

TREATMENT OF CATARACT BY OPERATION.

As long as useful vision is enjoyed by one eye, it would be injudicious to resort to operation; but when useful vision is completely lost, the cataract being what is called matured, the eye being in other respects perfectly sound, the general health good, any inflammatory tendency or plethoric state of the general system which may have existed having been removed, the stomach and bowels being in a proper state, the patient having been kept at rest for some days, the diet restricted, and a few doses of saline purgative medicines having been taken at intervals, recourse may be had to operation. It will not, however, be prudent to operate on the second eye, until some time has elapsed after the operation on the first.

We shall refer to three different operations for the cure of cataract, namely, the operation of *Extraction*, that of *Displacement*, and that of *Division*. As no one of these is of universal application, as each has its advantages, disadvantages, and dangers, and as each has its peculiar recommendations in certain circumstances, it is requisite that all three be distinctly understood.

OPERATION OF EXTRACTION.

This is particularly suitable for the removal of hard cataract; and indeed it is the only operative proceeding proper for that purpose. It has this recommendation, that, when successful, it effectually removes

the cataract ; but, unfortunately, there are various conditions both local and general, of not unfrequent occurrence, which would render it so extremely difficult or hazardous, that they are considered as decided contra-indications ; and this operation, therefore, is properly restricted to a limited class of cases.

The local conditions which contra-indicate this operation even in cases of hard cataract, are the following : adhesions of the iris to the cornea, or to the capsule of the lens ; a small size of the anterior chamber, either from natural conformation or from the iris being pressed forward by a large, although hard lens ; so small a palpebral aperture as to render it impossible to expose the globe of the eye sufficiently ; a deep position of the globe in the orbit—a condition which, as well as that last mentioned, would prevent the surgeon from making the section of the cornea in a proper manner—preternatural contraction of the pupil, called myosis (from *μύω*, *occludo*), and its remaining small after the application of belladonna ; a soft condition of the globe, which indicates a fluid state of the vitreous humour—a case in which an operation would be followed by the immediate or gradual escape of that humour, and consequent complete destruction of the eye—or a very unusual degree of firmness of the globe, which indicates a great excess of vitreous humour. Of the general conditions contra-indicating extraction, the principal are, a very inflammatory, or a very irritable system, either of which would be likely to induce inflammatory destruction of the eye ; a very feeble state of body, which would in all probability prevent the necessary process of adhesion ; cough, asthma, or any condition of the lungs or heart, attended with difficulty of respiration. Any of these last-mentioned conditions would be apt to cause escape of vitreous humour, or protrusion of the iris ; and, consequently, the operation in such cases would be very hazardous.

Only two instruments are required for this very delicate operation, the knife and the needle, bent at the point and fixed in a handle, or the curette. The knife usually employed is that of Professor Beer, of Vienna. The pupil being very moderately dilated, the patient seated in the erect posture, and the right eye covered by a bandage, if the left eye is to be the subject of operation, the surgeon places himself in front of the patient, and proceeds with the operation. This has been divided into three stages ; namely, 1st, opening the cornea with the knife ; 2d, opening the anterior hemisphere of the capsule ; and 3d, the extracting the lens, technically called the exit of the lens.

The assistant stands behind the patient, holding his head, opening the upper eyelid with the fore and middle fingers, and assisting at the same time in fixing the eye by gentle pressure on the globe. The surgeon then depresses the lower eyelid, and further assists in keeping the eye steady by the fore and middle fingers of his left hand, the middle finger resting on the *caruncula lachrymalis*. The knife being held as a pen, with the edge upwards, its point is inserted on the temporal side of the cornea, close to the transverse axis of the cornea, at the distance of about the twentieth of an inch from the sclerotic coat ; and lest the knife should be sent between the lamellæ of the cornea instead of into the anterior chamber, it should, until it enters the anterior chamber, be

held perpendicular to the surface of the cornea, as if the object were to send it against the iris. Penetration of the cornea having been effected—in other words, the point of the knife having been sent into the anterior chamber—the handle is then directed towards the temple, so as to make the blade of the knife parallel to the iris, and the knife is then steadily pressed on until it reach the point of exit, and counter-punctuation be effected; then, the eye being still commanded by the surgeon, who now brings down his middle finger to the lower eyelid, and directs the assistant to remove the pressure from the globe, the knife is carried on until section of the cornea be accomplished. This finishes the first stage of the operation.

The moment the section of the cornea is completed, the upper eyelid should be allowed to fall down, the eyelids to close, and the eye to rest for a few seconds. The errors to be guarded against during this stage are, sending the knife between the lamellæ of the cornea instead of into the interior chamber, wounding the iris with the point of the knife on completing punctuation, injuring the nose by not holding the handle sufficiently back to the temple after counter-punctuation has been effected, wounding the iris by the edge of the knife in completing the section of the cornea, or in carrying the knife onwards to the point of exit, and attempting to complete the flap by cutting a flap either by raising the knife, or indeed by any proceeding except that of sending it directly onwards after effecting counter-punctuation.

The sending the knife onwards completes the flap, whereas the consequence of endeavouring to cut a flap would be to separate the back of the blade of the knife from the uncut portion of the cornea below, thus allowing the aqueous humour to escape, and thereby causing the iris to fall forward on the edge of the knife. Too much pressure on the globe would also send forward the iris.

The eyelids should then be gently opened, and the capsule divided in a crucial form by the needle or the curette, the greatest care being taken not to touch the iris. This finishes the second stage. The eyelids should again be allowed to close for a few seconds, during which time the patient must be careful not to compress the eye by straining or pressing with the lids.

The surgeon then raises the upper eyelid with the thumb of his left hand, directs the patient to look down towards his nose, and in the gentlest manner possible presses on the upper part of the eyeball, and thus dislodges the lens, sending it through the pupil into the anterior chamber, and thence through the section of the cornea, after which a very accurate adjustment of the edges of the cut portion of cornea is to be effected, and the eyelids closed; and this finishes the third or last stage of the operation. The pressure by which dislodgment is accomplished must be applied with the utmost caution, and discontinued as soon as the greatest diameter of the lens is through the pupil, lest otherwise the hyaloid membrane should be ruptured, and the vitreous humour allowed to escape. Both eyes should be covered with a very light covering, consisting of not more than three or four folds of soft thin linen, secured by a single turn of a bandage or ribbon, to which the folds of linen should be fixed. By these appliances the eyelids will be preserved motionless and closed. The patient should be placed in bed,

lying on his back with the head and shoulders elevated; and this position must be continued for some days: he should be careful to avoid sneezing, or coughing, or holding down his head; his food must be of the most unstimulating nature, and given for some days in extremely small quantity, and in such a form as not to require mastication; every judicious means should be taken to prevent inflammation, or to subdue it if it should supervene; the eyelids should not, if possible, be opened for five or six days; the patient should be kept in a dark room, and every cause of excitement avoided; and not before two weeks at least, even in the most favourable cases, should the eyes be exposed to the stimulus of light; and even then, with the utmost caution, and only to a dull light.

DISPLACEMENT.

The operation of *displacement*, formerly called *couching*, the most ancient operation for cataract, should only be performed in cases of hard cataract, in which extraction is contra-indicated by some of the conditions already mentioned. We shall refer to two varieties of this operation, namely, *depression*, and *reclination*; the object aimed at in each being the removal of the opaque lens from the axis of vision. Each operation consists of three stages, the first and second of which are common to both, and shall therefore be first described; and afterwards we shall explain the mode of proceeding in the third stage of each separately.

The instrument generally preferred for these operations is Scarpa's needle.

The pupil having been dilated by belladonna, the patient placed on a low chair, with his head, upper eyelid, and eyes secured by an assistant, as in the operation of extraction, the surgeon seated on a chair higher than that on which his patient sits, holds the lower eyelid and the eye by the fore and middle fingers of one hand, takes hold of the needle as he would of a pencil with the right hand, if the operation is to be performed on the left eye, but with the left if on the right eye, and holding it horizontally with the convexity upwards, inserts it about one-sixth of an inch behind the corneal junction, precisely in the central transverse axis of the eye, and gently sends in the needle until the lance-shaped part of it has passed through the choroid into the vitreous humour. This completes the first stage of the operation. The above-mentioned distance from the corneal junction is selected to avoid the ciliary processes on one hand and the retina on the other; and the central transverse axis, to avoid the two branches into which the long ciliary artery divides about three-tenths of an inch behind the margin of the cornea.

In the second stage, the point of the instrument is made to divide the whole posterior hemisphere of the capsule; it is then brought under the lens into the posterior chamber, and the point of the needle, formerly turned forward to divide the posterior portion of the capsule, is, while in the posterior chamber, directed backwards, and the whole anterior hemisphere of the capsule is divided. This completes the division of the capsule, and the second stage of the operation.

The third stage of depression is commenced by placing the concavity of the needle on the upper part of the lens, and then by gentle manipulation the cataract is pressed downwards, and a little outwards and backwards into the vitreous humour. The needle should not be moved for a minute or two; and before withdrawing it, the operator should carefully observe that the cataract does not reascend, lest it should be necessary to depress it again.

If reclinatioⁿ be the operation to be performed, the concave part of the needle is placed against the front of the lens, a little above its centre, and by gentle manipulation is made to fall backwards and a little downwards, and outwards. It is thus made to recline or fall back, its anterior surface being turned upwards.

The principle on which the operation of displacement is founded, is considered by some of the greatest authorities as essentially bad; not so much on account of the cataract reascending, as of the occurrence, not very unfrequent, at length of chronic inflammation of the eye, dissolution of the hyaloid membrane, and amaurosis, results of the presence of an undissolved cataract in the unusual situation into which it is sent by the operation of displacement. This operation, therefore, should not be resorted to, except when extraction is contra-indicated.

OPERATION OF DIVISION.

The operation of division,—named also the operation for promoting absorption, and the operation for dissolution of the cataract,—is suitable for cases of fluid, and also of soft cataracts, and may be performed by division either through the sclerotic coat, or through the cornea.

The object aimed at in this operation is to submit the cataract to the influence of the aqueous humour, which has the property of dissolving it. The mode of admitting the humour into contact with the lens for the accomplishment of the desired solution, differs in the two varieties of the operation. Except in the case of fluid cataract, the operation requires to be performed more than once; but, when properly performed in suitable cases, it seldom fails to produce the desired result.

OPERATION OF DIVISION THROUGH THE SCLEROTICA.

The patient should be as carefully prepared for this operation as for displacement, and the eyelids and eye secured in the same manner. The same instrument is used, and the operations are in all respects the same until the needle is introduced into the posterior chamber. The convexity of the needle should then, by a partial revolution on its own axis, be directed forwards, and in that position sent inwards, until it is distinctly seen through the pupil; when by cautious manipulation the front of the capsule over a space rather larger than the natural size of the pupil should be cut into shreds. Complete mutilation of the capsule, to this extent, is desirable. Mere penetration would not be sufficient, as reunion might take place; and, on the other hand, to destroy the whole anterior portion of the capsule would be imprudent, as the lens might then fall forward on the iris. If the cataract be fluid, it will escape into the aqueous humour, cause a cloudy appearance, and be ultimately absorbed, and no further operation will be required. The

surgeon should content himself with the mutilation of the capsule at the first operation, and in two or three months the needle should be again introduced, and carried inwards in the same manner; and then by gentle movements with the needle, part of the lens may be broken down, and if perfectly soft, be sent through the pupil into the anterior chamber. In using the needle to break down the lens, it is very necessary not to send its point too far back, lest the posterior portion of the capsule be wounded, which would lead to opacity, and thus constitute capsular cataract.

Division through the cornea, named *keratonyxis*, is by many considered less hazardous than division through the sclerotic coat, inasmuch as fewer coats are wounded. The pupil must be previously dilated; the needle should be of a smaller size, having the round part, which is in the wound of the cornea during the last stage of the operation, of increasing thickness, so as to prevent escape of the aqueous humour. The needle should be introduced one-eighth of an inch from the margin of the cornea—the temporal aspect being in general the most convenient—and sent through the pupil. At the first operation, the surgeon should not do more than effect mutilation of the capsule to an extent equal to the size of the pupil. In the course of a few weeks the operation may be repeated, and a portion of the lens having been broken down by lateral movements with the needle, the fragments may be brought forward by movements of the needle, with its concavity forward. In this as in the former operation, care must be taken not to wound the posterior hemisphere of the capsule.

Division by drilling.—This modification of the operation of division was first suggested and practised by Mr. Tyrrell, who considers it particularly adapted for cases of capsular or capsulolenticular cataract, produced by extension of inflammation from the iris to the capsule, in which adhesions have been produced. A fine straight needle is sent through the cornea near its margin, and, passing through the pupil, is made to penetrate the capsule and enter the lens to the depth of about one-sixteenth of an inch; the handle is then made to rotate between the finger and thumb, so as to make the point act as a drill, after which the instrument is withdrawn. The operation is repeated in the course of a few weeks, and on each repetition of it a new part of the capsule and the lens is selected for the drilling.

SPURIOUS CATARACT.

Spurious cataract is constituted by effusion of coagulable lymph, as a result of inflammation of the iris, and of the capsule of the lens. If the lymph have a flocculent appearance, it is termed flocculent fibrinous cataract; if that of a small white clot adherent to the pupil, and generally also to the capsule, the term is clotted fibrinous cataract; if it consist of a bar extending across the pupil, it is called trabecular fibrinous cataract; if purulent matter be entangled in the lymph, purulent cataract; if blood be entangled in it, sanguineous cataract; or if part of the membrane which retains the pigmentum nigrum become detached in consequence of injury, and adherent to the capsule which is rendered

opaque by inflammation, induced probably by the same injury, it is termed pigmentous cataract.

GLAUCOMA.

Glaucoma (from *γλαυκος*, *viridis*) is the name given to an affection of the eye, in which a greenish appearance is seen on looking into the pupil.

State of parts as ascertained by dissection.—The following are the abnormal conditions most frequently met with: no trace of hyaloid membrane; the vitreous humour pellucid, or slightly yellow, but in a fluid state; no trace of limbus luteus, or of foramen centrale in the retina; little or no appearance of the pigmentum nigrum; the choroid coat of a light brown colour; and the lens, although still transparent, or nearly so, of an amber, yellow, or reddish brown colour. The opinion entertained by some authorities is, that glaucoma originates in inflammation of the hyaloid membrane, that this inflammation ends in its destruction, and that this destruction produces a series of other changes in the eye.

Symptoms.—Gradual loss of vision; dilatation and sluggishness of the pupil; a greenish appearance seated at a considerable distance behind the pupil, best seen on looking directly into the pupil, and disappearing entirely when the eye is looked at in profile; whereas in cataract the opacity does not disappear when looked at sideways. Before vision is lost, it is assisted by a strong light; and this is another diagnostic symptom between glaucoma and cataract. The catoptric test also assists in forming diagnosis; for in glaucoma the deep erect image is even more evident than in a sound eye; and it is only in the very advanced stage that the inverted image is obliterated.

It appears difficult to account for the greenish colour of a glaucomatous eye. On this symptom Mr. Mackenzie says, "The glaucomatous lens, viewed in its natural situation, seems of a greenish, sometimes of a deep sea-green colour. Remove it from the eye, the greenness is lost, and on being viewed against the light, it is found of a deep amber colour. The lens then, and the vitreous humour, which is also often yellowish in glaucoma, probably absorb the violet and blue rays of the light entering the eye, leaving the yellow and green rays but little affected, whence may result the green appearance of the humours. It is not improbable, however, that the appearance presented in advanced cases of glaucoma is not to be ascribed entirely to a reflection of the green rays of light from the amber-coloured lens, but partly to a reflection from the choroid at the bottom of the eye, that membrane being no longer capable of exercising its proper function from the defective state of the pigmentum nigrum. There is no green surface in the human eye to reflect the light of that colour, as there is in the eye of the sheep; it must then be either in its passage into the eye, or in its reflection out of it, that it acquires the greenish hue; and the part most likely to affect it in this way is the lens. Were it proved that the retina, which is naturally somewhat bluish, supported by a choroid destitute of pigment and a whitish sclerotica, reflects the light forward into the eye, of

a bluish colour, then one of the principal phenomena of glaucoma might be regarded as no longer difficult of explanation. In confirmation of this, if the lens is removed in this disease, or sinks to the bottom of the dissolved vitreous humour, the green appearance is almost entirely lost."

Treatment.—It is only at the very commencement of this disease that any benefit can be afforded by treatment under the use of local depletion, counter-irritation, mercury in a mild form, rest of the eye, and the employment of the remedies suitable for the rheumatic or gouty diathesis, if symptoms of either present themselves. In some cases, at that period, the symptoms of glaucoma seem to be retarded, if not improved; but in a more advanced stage, or in the glaucomatous state which comes on occasionally at an advanced period of life, no treatment is of the slightest benefit.

AMAUROSIS.

Definition.—The term amaurosis (from *αμαρῶω*, *obscurare*) is used to denote obscurity of vision depending on disturbance, or change in some part of the nervous apparatus belonging to the organ of vision, or communicating with it, that is to say, in the retina, optic nerve, or brain.

Synonyms.—It is the gutta serena of the Arabians. Some of the many other terms which have been employed to denote this affection are amblyopia (from *αμβλῦς*, *obtusus*, and *ὀπτομαι*, *video*), cataracta nigra, and suffusio nigra.

Proximate cause.—The principal causes of amaurosis, are structural changes in some part of the nervous apparatus connected with the organ of vision, occasioned by some grade of inflammation in the retina, optic nerve, or brain; changes in the retina induced by inflammation, scrofulous or malignant disease; pressure on its concave surface by vitreous dropsy; pressure on its convex surface by effusion from parts external to the retina; changes induced by pressure on the portion of optic nerve within the orbit,—a part which, although seldom the subject of disease commencing in itself, is occasionally compressed by results of inflammation by tumours, or by aneurism within the orbit; inflammation or congestion within the cranium, or products of inflammation having its seat in the membranes of the brain, or in the portions of brain connected with the organs of vision; tumours; extravasated blood; and softening of parts of the brain connected with the optic nerve.

Such are the principal conditions on which amaurosis depends: but any state which makes the retina incapable of receiving with correctness the impressions of external objects, or the optic nerve incapable of transmitting impressions received on the retina, or the portion of brain connected with the optic nerve unfit for receiving those impressions, may be a proximate cause of this disease.

Predisposing and exciting causes.—The fact that several members of the same family have in successive generations become affected with amaurosis, is strong evidence that hereditary predisposition is one cause of it. Some of the most respected authorities are of opinion that the form of amaurosis which is most frequently observed to be hereditary, is

that which depends on organic disease ; that it is more frequently met with in elderly than in young persons, and in females than males ; that it is most common in individuals with black irides, and that it is seldom confined to one eye. Long-continued over-exertion of the eye, especially long-continued perception of minute or luminous objects, has often been found to be an exciting cause of this disease ; and the form thus induced is usually the congestive variety. This variety is most common in persons with light coloured or blue irides, and it occurs in the majority of cases at an earlier period of life than that which arises from organic disease. Literary men, engravers, watchmakers, and tailors are often the subjects of this variety. Vascular fulness in consequence of the arrest of some inordinate discharge or long-continued evacuation, or in consequence of over-exertion, or the use of wine or spirits, furnishes in many cases an exciting cause. In some cases the disease has been known to be caused by wounds of the forehead or near the orbit, and not on the eye itself, and in others by a single injudicious exposure of the eye to an exceedingly bright light, the sensibility of the retina being thereby destroyed. In some instances injury and irritation of some of the branches of the fifth nerve have been found to be the exciting cause, the rationale of which cannot be easily explained ; and in others long-continued gastric and intestinal irritation, typhus fever, great exhaustion caused by some excessive evacuation or by long-continued discharge, and debility from great mental anxiety, have operated as exciting causes. These are some of the unfavourable influences by which amaurosis has often been induced, but in the majority of cases it owes its origin to the continual operation of several exciting causes.

Symptoms.—These are numerous and varied. Of the subjective symptoms, those which are referable to the feelings and perceptions of the patient, the principal are the following :—impairment of vision, or some defect in the perception of objects. The impairment may vary from slight weakness of sight—called by some, imperfect or incomplete amaurosis ; by others, amblyopia amaurotica—to total blindness, or what is called perfect amaurosis. Sometimes in the early stage the defect of sight is not permanent, but returns at regular or irregular intervals, constituting the amaurosis vaga of some authors. *Nyctalopia*, or day-blindness, and *hæmeralopia*, or night-blindness, are examples of periodic amaurosis. In general, however, the periodic soon changes into the permanent form. In some cases the failure of sight assumes the *myopic* or *presbyopic* form, that is, the person becomes short- or long-sighted. Both varieties are met with, but the latter is the more common. Occasionally, in the early stage, objects are seen covered with a dense mist, a symptom called *visus nebulosus* ; and in some instances this mist appears to the patient as a constantly-increasing cloud : in others it appears at first of a light gray colour, and afterwards like dense black smoke between the eye and the object. In imperfect amaurosis, objects sometimes appear disfigured (*visus defiguratus*), lengthened, shortened, bent, and in some instances inverted. The flame of a candle sometimes appears very long, and, as it were, divided into several portions. Beer regards this as a very unfavourable symptom, his experience having led

him to conclude that it is indicative of disease of the brain. In a case at present under my observation, the flame of a candle appears to the patient elongated and very much bent, without being divided into different parts. Other peculiarities are, that some patients see only half an object at one time; this symptom is named *visus hemiopia*. Some see parts of an object, other parts being concealed from view; for example in looking at a word, some syllables—or at a line, several words—are seen at different parts; this is called *visus interruptus*. Others see objects only when held obliquely, or in certain directions; this is termed *visus obliquus*. Such are the principal defects of vision; but many amaurotic patients have illusive perceptions of objects, and these vary much in appearance. Sometimes the patient fancies he sees flies or gnats flying before his eyes; these appearances are named *muscæ volitantes*; and this peculiarity is called *visus muscarum*. Sometimes all objects appear as if obscured by a network or gauze; a symptom termed *visus reticulatus*. This network usually presents a white, shining, silvery appearance in dark places, or when black objects are looked at, and a dark appearance in light situations, or when white objects are looked at. Objects are sometimes seen of wrong colours; this is called *visus coloratus*; and in many examples of amaurosis, a very distressing symptom is the perception of fiery balls or bright flashes of light passing suddenly before the eyes when the eyelids are shut; this is called *photopsia*; it is an early symptom, is most common in plethoric persons, and is usually attended with considerable alarm. Some patients, in the early stage, dread the light—a symptom called *photophobia*; whilst others have what has been called “a thirst for light,” and a desire for a great degree of illumination of objects. The above are the principal symptoms referable to impairment and perversion of sight.

Sometimes in amaurotic cases there is a feeling of weight about the eye; sometimes pain in the eye and in the neighbouring parts of the face, in the brow, or in the head; sometimes patients have an unpleasant feeling of dryness in the eye and nostrils; and in some cases the disease is accompanied with giddiness, dizziness, tinnitus aurium, and a sense of fulness in the head, aggravated by exercise and the horizontal posture. The seat and peculiarities of the pain, and the history of the patient's health, will furnish important information both for diagnosis and treatment.

The principal objective symptoms, or those which are discoverable on examining the patient, are the following:—

In the early stage the pupil is in general sluggish and limited in its motion, and, in the advanced stage, dilated and motionless. This, however, is not invariably the case; for in some examples of perfect amaurosis of both eyes, the pupils have been found to vary in size according to the degree of light; and in others of complete darkness, where one eye only was affected, the pupil of the amaurotic eye has been found to change as in health, according to the degree of light admitted to the sound eye. This suggests the propriety of covering the sound eye, while the other is under examination. Generally, however, notwithstanding the above peculiarities, the early and advanced stages are attended with the conditions of the pupil already mentioned. In some

instances the pupil has its natural black appearance, more especially in cases depending on affections of the brain; but more commonly it has somewhat of a cloudy or glaucomatous appearance. The patient does not converge his eyes towards objects placed before him. The application of the catoptrical test should never be omitted; it shows the three images as in a sound eye. There is a vacant expression and a peculiar stare about the eye, together with an uncertainty in the movements of the patient, and a peculiarity of gait quite characteristic of the affection. By the above-mentioned symptoms amaurosis may be readily distinguished from cataract and glaucoma.

Cases of complete amaurosis occasionally occur, in which very few of the ordinary symptoms are present. A striking example of this fact occurred in a patient under my own care about ten years ago, Mr. Watt, guard of the Defiance coach, then running between Edinburgh and Aberdeen. He had perfect amaurosis of his left eye; and the only symptoms were total blindness of the eye, dilatation of the pupil, and a motionless condition of the iris. The history of this case is somewhat remarkable. When giving Mr. Watt a prescription for some temporary derangement of his bowels, I observed, while he was sitting with his face to the window in a bright light, that the pupil of his left eye was exceedingly dilated, and that the iris was perfectly motionless. Not knowing that he was not aware of the state of his left eye, I asked him how long it was since he lost the sight of his left eye? His reply was, "Lost the sight of my left eye, sir? I have not lost the sight of my left eye." I requested him to close his right eye; and on recovering from his confusion and alarm at finding that he was totally blind of one eye, his first exclamation was, "That is a most alarming discovery, sir, you have made; and how long is it, sir, since I lost the sight of my left eye?" That I told him was the question I wished him to answer. I was in the habit of seeing Mr. Watt for several years, and his eye remained in the same state, and he had no uneasy sensation about the head or eye, or any symptoms whatever referable to that region of the body, except those mentioned above.

Treatment.—From what has been stated as to the exciting and proximate causes of amaurosis, the principles of treatment applicable to its different varieties, and the suitable means for carrying them out, will at once be evident; so that it appears unnecessary here to say anything further than that it is only at the very commencement of the incipient stage that any benefit can be expected from treatment even in the most favourable cases; and that without relinquishment of the exciting cause and perfect rest of the organ, the best-directed treatment in other respects will be of no avail.

EXTIRPATION OF THE EYE.

The patient having been placed on his back, or in a chair with the shoulder and head raised and supported, chloroform having been administered, and the charge of the eyelids given to an assistant, whose duty it is to raise the upper eyelid by means of Pellier's speculum, and to keep the eyelids as much as possible out of the way of the knife during the cutting part of the operation, the operator disunites the eyelids from

each other at the outer commissure by making a horizontal incision outwards for about half an inch beyond the orbit, so as to allow the wide separation of the eyelids; he then passes a large curved needle armed with a double, waxed ligature, through the eyeball from side to side behind the cornea, and having cut off the needle, ties the two ends of the thick strong ligature together. As the object of this proceeding is to obtain a suitable means of applying traction to the eyeball while it is being detached from its surrounding connexions, the insertion of the needle should be so far back behind the cornea as to get hold of a part not likely to give way during the operation. Another mode of obtaining the command of the eye is by seizing it with a vulsellum. A scalpel or bistoury is then inserted between the eyeball and the inner canthus, and carried between the eye and under eyelid and round the ball, so as to divide the conjunctiva, and then by a few sweeps with the knife the muscles are cut through and the optic nerve divided, the eye being drawn by the ligature in various directions to give room for the movements of the knife. Two points should be attended to in the cutting part of the operation, namely, to leave as little as possible of the optic nerve in the orbit, and if the future use of an artificial eye be contemplated, to leave as much conjunctiva as may be in a healthy state attached to the eyelids. Any hemorrhage may be easily commanded by the introduction of lint within the orbit. The edges of the wound made in disuniting the eyelids are brought together by a suture and an exceedingly light compress, and one or two turns of a roller are applied; after which the patient should be kept very quiet, and every judicious precaution taken to prevent the occurrence of any high degree of inflammation.

STRABISMUS.

Definition.—Strabismus (from *στραβος*, *qui est oculis distortis*) denotes that condition of the eyes in which the optical axes do not converge to the same point; of this there are two forms, strabismus convergens, in which the eye looks inwards, and strabismus divergens, in which it looks outwards, the former being the more common. This affection depends on a disturbance of the balance of action of the recti muscles, which disturbance may sometimes be caused by excessive action of one muscle, but in most instances it probably arises from one muscle being enfeebled so as to be unable to resist its antagonist drawing the eye to the opposite side. This is rendered probable by the difference observed in the result when the internal rectus is divided by accident, and when divided in the operation for the cure of strabismus. In the former case the eye is turned completely outwards, whereas in the latter the external rectus usually brings the eye only into its proper position.

Cases of strabismus proceeding from gastric, intestinal, or uterine derangement, from general debility, or from affections of the brain, are all unfit for operation; as also are all cases in which the deformity is in consequence of opacity in the cornea, the distortion in such instances being an effort to remove the opacity from the axis of vision.

Cases fit for operation are those in which the strabismus is confirmed,

and in which there is no evidence of an exciting cause calculated to keep up or to bring back a disturbance in the equilibrium of muscular action within the orbit. In the chapter on Talipes some principles are mentioned for the guidance of the surgeon in the selection of cases for operation for the cure of that deformity : many of the same principles are applicable to the selection of cases for operation for the cure of strabismus.

The operation for strabismus is that which was first suggested by Stromeyer of Hanover, and soon afterwards practised by Diefenbach of Berlin, by Pauli of Landau, and in a short time by surgeons generally. Having performed it above one hundred times, I feel myself justified in stating my firm conviction, that if only fit cases are selected, it will be found most satisfactory in its results. The object of operation in strabismus convergens is to divide the internal rectus, and in strabismus divergens, the external.

There are many varieties as to the instruments which have been employed, and in some respects as to the mode of performing this little operation.

With regard to instruments nothing more convenient need be desired than Pellier's speculum for keeping up the eyelid, a double hook invented for this operation, a forceps for raising, and a small pair of scissors for dividing the parts.

The operation for strabismus internus may be performed in the following manner. The patient being placed in a chair, the upper eyelid raised by Pellier's speculum, the under eyelid depressed, and the eye drawn outwards by means of the hook fixed in the conjunctiva fully a line behind the cornea, the speculum and hook being both held by an assistant, the operator pinches up the conjunctiva with the forceps, and makes a vertical incision about half an inch in length, and fully from two to three lines behind the cornea. By a few snips with the scissors, the tendon is exposed and divided ; and if, on removing the hook, the eye be slightly turned outwards at first, or the patient unable to turn it inwards to its former position, the operation may be considered perfectly satisfactory.

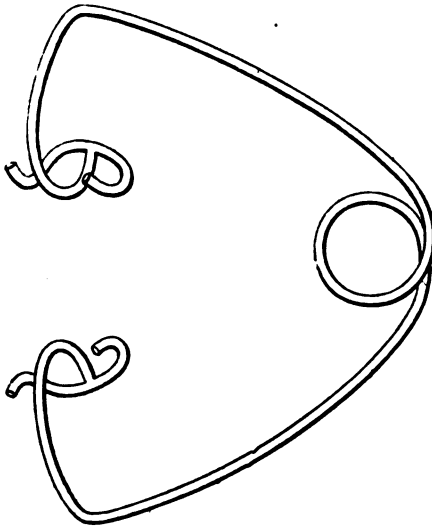
I am sure that no better mode of performing this operation need be desired ; but after dividing the conjunctiva, as already described, the operation may be completed by other modes ; for example, by raising the tendon with a small hook, bringing it very slightly forward, and dividing it with the scissors ; or a small grooved director and a small curved bistoury, both of which have been invented for this operation, may be used, the one for raising, and the other for dividing the tendon. Another mode of proceeding is to direct the patient to look outwards, and then to pinch up the conjunctiva with a forceps at once, and thus to dispense with the use of the small double hook for holding the eye. For obvious reasons, chloroform is not used in this operation.

[Notwithstanding the simplicity of the operation, I have seen surgeons embarrassed for the want of a properly curved hook, with which to seize the muscle. The form recommended by Dr. Hays, of this city, I have found admirably adapted to the purpose. Dr. Hays gives the following description of the operation for strabismus internus.

"The patient is seated facing the light, on a chair without a back or on a stool, of such a height that his or her head will rest upon the breast of an assistant seated on an ordinary chair behind. The eye not to be operated on is to be bound up with a compress and bandage. The surgeon is to be seated on a common chair facing the patient.

"The first step of the operation consists in the separation of the eyelids. This may be effected by the assistant, if he is a skilful one. For this purpose, if the left eye is to be operated on, he should raise the upper lid with the forefinger of his right hand, and depress the lower lid with the forefinger of his left hand. When the right eye is to be operated on, the upper lid is to be raised with the forefinger of the left hand, and the lower one depressed with the forefinger of the right hand. When the assistant cannot be depended on, the lids may be separated by a speculum; and the best for this purpose we have seen, is the elastic steel wire speculum, represented in the accompanying figure (Fig. 261). The two branches are to be pressed to-

Fig. 261.



gether, one end introduced under the upper and the other under the lower lid; the force of the spring then separates the lids. An instrument, which also answers extremely well, has been devised by Drs. P. B. Goddard and W. W. Ruschenberger. It is made of silver wire, somewhat similar in form to that just figured, but it is constructed in two separate pieces, to one of which is attached a cylinder, and to the other a rod which slides in the former. When this instrument is applied, and the branches separated, the friction of the rod against the cylinder will effectually resist any effort of the patient to close the lids.

"The second step is the division of the conjunctiva. The patient being directed to turn the eye outward, the surgeon takes

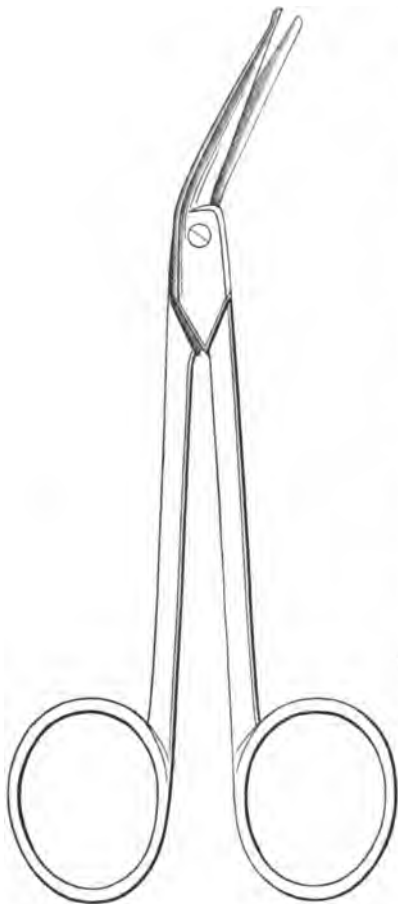
the small toothed forceps (Fig. 262), and seizes the conjunctiva,

Fig. 262.



about midway between the edge of the cornea and the caruncula lachrymalis, or rather a little

Fig. 263.



nearer to the latter, so as to make a horizontal fold, which is then snipped across with the scissors (Fig. 263), close to the forceps, and between them and the cornea. When the left eye is operated on, the forceps should be held in the left hand, and the scissors in the right, with the probe-pointed blade upwards. When the right eye is operated on, the forceps are to be held in the right and the scissors in the left hand. If the first incision is not sufficiently large it may be extended above and below. A very good method of dividing the conjunctiva is with the small iris knife (Fig. 264). If the point of this be thrust through the fold of the conjunctiva from below upwards, with a single cut a sufficiently extensive incision may always be made. The conjunctiva being divided, the surgeon still holding the inner flap with the forceps and drawing it forwards, is to separate it to a sufficient extent from the sclerotica, either by dissection with the scissors, or what is more convenient, with one of the small knives represented at p. 637, Figs. 97 and 98.¹ Some surgeons object to this dissection under the

belief that it subjects the patient to protrusion of the globe. We have never found this to result in any of our operations, and the dissection we recommend, much facilitates the subsequent steps of the operation. If blood now flows so as to obscure the parts, which does not often

¹ Lawrence on the Eye.

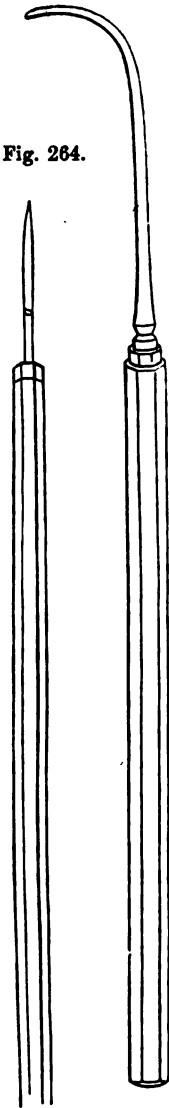
happen, it is to be carefully wiped away with a small sponge, attached to the end of a probe, and tepid water.

"The third step in the operation consists in the introduction of the blunt hook under the muscle. This sometimes presents difficulties to the inexperienced operator, which may be obviated by the use of a hook such as is represented in Fig. 265. It is formed of silver wire, as small as is consistent with the necessary strength, set in a bone handle, and is bent at the end so as to accommodate itself exactly to the curvature of the eyeball, and flattened at the point on its convex surface. The globe of the eye being a sphere of $\frac{1}{2}$ ths of an inch in diameter, the proper curve may be given to the hook by bending it on a cylinder of that diameter. The surgeon takes this blunt hook in his right hand when operating on the left eye, and in his left hand when operating upon the right eye, and applying its concave surface to the eye, he inserts the point beneath the conjunctiva, the handle being elevated, and pushes it backwards and downwards until the point is below the muscle and behind its insertion. He then rotates the instrument so as to turn the point backwards and upwards, and at the same time depressing the handle, the point glides under the muscle and appears at its upper edge covered with the fascia which has been pushed before the instrument: some surgeons recommend that the fascia should now be cut so as to bring the point of the hook entirely out; but this is not necessary. The muscle is now secure and the surgeon gently draws the eye outwards.¹

"The last step in the operation consists in the division of the muscle. Incomparably the safest and best instrument for this purpose is the scissors represented in Fig. 263. The surgeon takes the instrument in the hand which is disengaged, so that the probe-pointed blade is towards the eye, passes that blade beneath the muscle close to the convex surface of the hook, and with a single cut divides the muscle. The patient may now be allowed to close the eye, and to rest awhile. After the lapse of a minute or two the lids should be separated and the condition of the eye examined. If the pupil is now in the centre of the orbit, and the patient cannot turn the eye horizontally inwards, the operation may be considered as complete. If the patient can, however, rotate the cornea into the inner canthus, it will be found that a portion of the muscle or some tendinous fibres

Fig. 265.

Fig. 264.



¹ Mr. T. Wharton Jones (Principles and Practice of Ophthalmic Medicine and Surgery, sect. 1996), recommends that the probe be passed under the tendon from above downwards, which seems to be preferable to the mode we have adopted, as it secures the ball from rolling upwards, during the division of the tendon with the scissors, and we shall try this method the first opportunity which presents.

remain to be divided. These are to be sought for with the blunt hook, and being raised on it, divided with the scissors. This is the part of the operation which requires most judgment and tact. If the fascia is too extensively divided the eye will become too prominent, or an external squint may result; both of which are more disagreeable deformities than internal strabismus. On the contrary, if the muscle is not completely divided with any adventitious fibrous bands which may exist, the squint will be but partially corrected, or when the muscle reunites may be reproduced. The muscle and fasciæ should be simply cut across, and all dissection and separation of these parts from the globe of the eye avoided, except where the defect has resulted from repeated attacks of inflammation which have consolidated the cellular tissue, fasciæ and muscles, giving rise to adventitious bands, &c.

"No dressing is required to the eye operated on, except a rag wet with cold water. We recommend the patient to use it exclusively for a few days, and to turn it outwards, as far as possible, many times during that period, the other eye being kept bound up. Afterwards we desire him to look with both eyes at distant objects, so as to acquire parallelism of the eyes. This may be aided by holding a large book against the nose, and directing both eyes to some remote object.

"We have never found any inflammation follow the operation requiring treatment; but as a matter of precaution advise the patient to keep in a darkened room, to abstain from stimulating articles of food for two or three days, and to take a dose of salts the night after the operation.

"This mode of operating causes very little pain, is perfectly simple, and three instruments, a pair of forceps (Fig. 262), a pair of scissors (Fig. 263), and a blunt-pointed probe (Fig. 265), are all that are absolutely required. The hooks employed by surgeons to evert the eye, always give pain, sometimes inflict injury, and are never necessary in cases suitable for the operation.

"This method is, of course, not applicable to young children, but such, we conceive, to be very improper subjects for the operation. The deformity is of little consequence to them, and it is sufficiently early to attempt its removal when they have arrived at an age to appreciate the importance of the operation, and have acquired sufficient firmness to offer no resistance."—*Ed.*]

AFFECTIONS OF THE EYELIDS, AND OF THE LACHRYMAL APPARATUS.

HORDEOLUM, OR STYE.

Hordeolum, a diminutive of hordeum, *barley*, is a name given to an inflammatory swelling near the margin of the eyelid on account of its usually being about the size of a small barleycorn.

This affection is most commonly met with in young persons of a scrofulous diathesis, and it is most frequently brought on by exposure to cold and sharp winds, while the digestive organs are in a disordered state. Late hours and the use of spirits or wines are also exciting causes.

At first the patient feels itching or slight smarting, but this soon

gives way to pain, tenderness, tension, and great sensibility; the swelling, which at first is of a bright red, gradually becomes darker and of a purplish hue; the form becomes conical, and after pus has been formed, the apex presents a yellow colour. The swelling sometimes subsides without going on to suppuration; but in most cases it suppurates and bursts, after which the swelling in general very soon subsides and heals up, but sometimes it degenerates into *grando*; sometimes it returns in consequence of the whole of the matter not having been discharged; and sometimes its healing is retarded by the disorganized cellular tissue being long in coming away. In many cases *hordeolum* consists of a small acute abscess caused by obstruction, retention of the contents and consequent inflammation of a meibomian follicle.

With regard to treatment, the digestive organs should be carefully regulated, and a proper condition of their secretions promoted. A smart purgative, and cold applications in the incipient stage, will sometimes stop the disease. When the inflammatory process advances, these must be changed for emollient applications, as fomentations, simple or medicated, or light poultices; and when matter is formed, the abscess should be opened: after which tepid water-dressings may be continued, and if the disorganized cellular tissue be long in coming away, the healing of the part will be greatly promoted by touching the cavity with a small pencil of nitrate of silver.

PHLYCTENULA, GRANDO, AND MILIUM.

Phlyctenula, or a small semitransparent vesicle formed by the cuticle near the margin of the palpebra being elevated by a portion of serum, is often observed. Sometimes there is but one vesicle, sometimes there are several; and they vary in size, but are not generally larger in volume than a small shot. The vesicle is apt to return, if it be merely opened; but if a considerable portion of it be removed by a snip of a pair of scissors, there is very rarely any return.

Small white superficial painless swellings, formed by the skin being raised by a suet-like substance, are often met with in the palpebræ. When such a swelling is about the size of an ordinary hailstone, it is called *grando*; and when it resembles a millet-seed, *miliun*. All that is necessary for the cure of these swellings is to open the skin and press out the contents.

OPHTHALMIA TARSI.

Synonyms.—*Ophthalmia tarsi*, *psorophthalmia*, *scabies palpebrarum*, and *tinea ciliarum*, are some of the various names given to a peculiar and generally tedious inflammation of the edges of the eyelids.

Symptoms.—Itching and irritation in the ciliary margin are the first sensations: and as the disease advances, these give way to soreness, tenderness, and if the disease be acute, to sharp pain. Soreness, slight feeling of heat, and stiffness, however, are the chief sensations after the disease has existed for some time. According to the degree in which the conjunctiva participates in the inflammation, the patient complains of slight lachrymation, weakness, intolerance of light, and a feeling of sand between the eyeball and eyelids. The eyelids are glued together

in the morning by a viscid coagulated secretion; and the incrustation thus formed binds the edges so firmly together that they cannot be easily separated without much bathing. By injudicious efforts to separate the eyelids without previous bathing, the eyelashes are often drawn out. The edges of the eyelids become thickened and red as the disease advances. Some of the cilia at their bases are enveloped in coagulated secretion, on the removal of which small ulcers or pustules are observable. By the spreading of these ulcers, the margins acquire a raw appearance, and the cilia become first irregular, and ultimately almost entirely removed, the surface being raw, swollen, and thickened. The eyes have what has been called a bleared appearance. At first the edges are inflamed and affected with small pustules or ulcers; thickening of the edges and irregularity of cilia next occur; and lastly the cilia disappear, and the edges present a raw appearance.

It is believed that generally the meibomian follicles are first affected; but these, the roots of the eyelashes, the skin, and the conjunctiva, are all more or less involved; and loss of the cilia, obliteration of the meibomian follicles, thickening of the palpebræ, and eversion of the lower eyelid, are some of the sequelæ of this disease.

The disease occurs in scrofulous subjects as a primary affection; but it is more frequently a consequence of some other disease, such as measles, scarlatina, catarrhal or strumous ophthalmia.

Treatment.—In the first stage, when acute, the treatment comprehends slight depletion by scarifying the palpebral portion of the conjunctiva, warm emollient or opiate fomentations, and very careful bathing of the eyelids before opening them. The scabs must be cleared away with much caution from the bases of the cilia. At a more advanced stage, the occasional use of astringent or stimulating collyria during the day, and the application of an ointment at night, constitute the proper treatment. The collyria generally preferred are weak solutions of sulphate of zinc, or nitrate of silver, or corrosive sublimate; and the ointments, that of the carefully-levigated red precipitate of mercury mixed with fresh butter, or that of the nitrate of mercury very much diluted.

The cilia sometimes require to be pulled out, when there is much ulceration around their roots; and sometimes much benefit is derived from touching the small ulcers very gently with the nitrate of silver. All sources of local irritation must be guarded against: the functions of the skin, stomach, and bowels attended to; and if the patient be scrofulous, the treatment for that diathesis must be instituted. When this disease has produced entire destruction of the cilia, with a thickened, florid, everted, and excoriated state of the edges of the eyelids, the condition receives the name of lippitudo.

TRICHIASIS AND DISTICHIASIS.

Trichiasis (from *τριχ*, *crinis*) is a term used to denote a growth of one or more cilia towards the ball of the eye, and distichiasis (from *δύς*, *bis*, and *σῶχος*, *ordo*) to denote a double order of cilia.

These affections are caused by contraction of cicatrices consequent on ophthalmia tarsi, wound, ulcer, or some chronic affection of the palpebræ.

They give rise to irritation, lachrymation, weakness of the eye, ophthalmia, and, if not removed, a nebulous and vascular condition of the cornea, and ultimately ulceration and opacity of the cornea, and impairment of vision.

The pseudo-cilia are always very fine and light-coloured, and in distichiasis they never occupy the whole length of the eyelid, but appear at different parts.

The inverted cilia should be pulled out by means of a fine forceps; and if, after careful and frequent repetition of this proceeding, they still reappear, the portion of the palpebral margin containing the pseudo-cilia may be carefully and smoothly cut off, and by that means a radical cure obtained. My limits will not permit me to describe other modes of treatment recommended for these distressing affections.

ENTROPIUM.

Entropium (from *av*, *in*, and *επισκω*, *verto*) is the name given to inversion of the eyelid, a condition which gives rise to—lachrymation; pain, especially in moving the eye; irritation, as if produced by a foreign body; intolerance of light; inability to use the eye; a degree of ophthalmia; nebulous opacity of the cornea; and impairment of vision.

Causes.—Entropium most frequently depends on an extremely lax condition of the common integument, in consequence of which the orbicularis palpebrarum is unable to preserve the lid in its proper position. Sometimes it arises from contracted cicatrix of the palpebral portion of the conjunctiva; a state which may follow ulceration, a burn, a wound, or destruction of the conjunctiva by an escharotic. A third condition which gives rise to it is thickening of the conjunctiva at the junction of the ocular and palpebral portions: as the swelling presses the eyelid from the ball of the eye and causing inversion. In some instances swelling causes eversion, as was mentioned in the description of some of the forms of ophthalmia, and in others it produces inversion. A fourth and very troublesome cause of entropium is contraction of the tarsus, a condition not unfrequently induced by a long-continued strumous ophthalmia.

Treatment.—When entropium depends on the first or second of these causes, the treatment consists in pinching up a longitudinal fold of the integument of the eyelid, and removing it by the knife or the scissors, great care being taken to raise and remove the precise quantity of integument necessary for obviating inversion, without inducing eversion. When it proceeds from the third cause, the swelling should be combatted by treatment proper for the condition on which it depends. For the cure of entropium proceeding from contracted tarsus, various methods have been adopted. That practised by Mr. Tyrell, and uniformly successful in his hands, is to make a perpendicular section of the lid, near its centre, through its whole thickness. The tension is removed, and the wound granulates and leaves but little deformity. Another method is that recommended by Crampton, and adopted by many ophthalmic surgeons, namely, to make two perpendicular sections, one at each extremity of the contracted portion of the tarsus, to unite them

by a deep horizontal incision on the ocular aspect of the eyelid, and to suspend the palpebra for some time. The treatment for distichiasis has been instituted by some surgeons for the cure of this deformity.

ECTROPIUM.

By ectropium (from *εκ*, and *τροπω*, *verto*) is meant eversion of the eyelid; a state which gives rise to—epiphora, or watering of the eye, owing principally to the displacement of the punctum; to irritation and excretion of the cheek, induced by the secretion from the eye flowing over the cheek; to inflammation of the conjunctiva; and ultimately, if it be not removed, to structural changes both in the conjunctiva and the cornea. Exposure to atmospheric changes and lodgment of foreign matter are apt to induce inflammation in the palpebral and ocular divisions of the conjunctiva.

Ectropium may proceed from acute or chronic enlargement of the conjunctiva lining the eyelid; from relaxation and elongation of the tarsus; from contraction of cicatrices on the face, from divisions of either canthus by wound; or from combinations of these conditions.

The enlargement of the conjunctiva is to be treated according to common principles, and when other means fail and the condition becomes chronic, by excision; elongation is most successfully treated by excision of a part in the form of a letter V; contraction of cicatrices by removal of the cicatrices and transplantation of a portion of skin from the cheek or temple; and division of canthus, by making raw edges, bringing them into apposition, and preserving them in contact by suitable retentive means until union be accomplished.

AFFECTIONS OF THE LACHRYMAL APPARATUS.

EPIPHORA.

Epiphora (from *ἐπι*, *supra*, and *φέρω*, *fero*) is an overflowing or undue secretion of the tears, so that there is habitually a watery eye, and a frequent dropping of tears over the cheek.

Epiphora differs from stillicidium lachrymarum, in that it consists in an over-secretion of tears, whereas the latter is a dropping of tears owing to some obstruction in the lachrymal apparatus for carrying them to the nose.

As a disease in itself, epiphora is much less frequent than as a symptom of trichiasis, entropium, the presence of some foreign body underneath the eyelid or in the conjunctiva, scrofulous ophthalmia, or some other disease of the eye or its appendages. It is not unfrequently a symptom of teething, of disorder of the digestive organs, of worms in the intestines, and of general debility; and in some cases it appears to proceed from general irritability of the eye.

From this statement it will be evident that it will seldom be necessary to prescribe for epiphora, but that in every case a minute examination should be made of the state of the eye and its appendages; and that in some instances local, in some general, and in others local and general, treatment will be necessary for the removal of the condition, of which epiphora may be a symptom.

XEROMA, OR XEROPHTHALMIA.

Xeroma, and xerophthalmia (from ξηρος, *siccus*, and ομα, *visum*, and οφθαλμος, *oculus*) are terms used to denote the very reverse of the last-mentioned affection—a dryness of the eye instead of an excess in the secretion of tears. As a separate disease, I have not seen an example of this precise affection. There are, it is understood, two distinct varieties of it; namely, lachrymal dryness of the eye, depending on a suppressed or deficient secretion of tears, and conjunctival dryness, arising from deficiency of the mucous secretion which lubricates the surface of the eye. It is met with in old persons sometimes alone, and sometimes in connexion with amaurosis; and it is well known to be sometimes a symptom at an earlier period of life of amaurosis in its incipient stage. It is also said to take place as a consequence of disease of the lachrymal gland, as well as of great deficiency of nervous energy, and to be attended with this peculiarity, that the eye looks as moist and slippery as usual, although the patient complains of its being stiff and dry.

DACRYOCYSTITIS.

Dacryocystitis (from δακρυ, *lachryma*, and κυστις, *vesica*) is the term given to inflammation of the lachrymal sac. Of this there are two varieties, acute and chronic.

DACRYOCYSTITIS ACUTA, OR ACUTE INFLAMMATION OF THE LACHRYMAL SAC.

Symptoms.—The symptoms are, pain of a deep-seated, throbbing, and lancinating character, principally in the situation of the lachrymal sac, but extending also to the surrounding parts; swelling, commencing underneath the tendo palpebrarum, corresponding at first to the boundaries of the sac. The swelling is exceedingly tender to the touch, and hard at first, but afterwards becomes elastic, and ultimately acquires a feeling of fluctuation: it is very red and extremely painful, and as the inflammation extends to the surrounding parts, the redness becomes diffused, and the eyelids swollen and oedematous from effusion into the cellular tissue. The caruncula lachrymalis becomes inflamed, the puncta scarcely perceptible, and the transmission of tears through the lachrymal passages completely interrupted; hence the stillicidium lachrymarum, and the dryness of the nostril on the affected side, to the membrane of which the inflammation also frequently extends. If resolution do not take place, and suppuration occur, the matter makes its way to the surface by ulcerative absorption, and is discharged. As the inflammation advances, patients usually experience pain not only in the situation of the lachrymal sac and surrounding parts, but also in the head; and in severe cases they exhibit the usual symptoms of sympathetic fever. Fistula, permanent obstruction of lachrymal canals and duct, and extension of the disease to the periosteum and bone, are the dangers to be apprehended in severe and neglected cases. The disease usually originates in the mucous membrane of the palpebræ, and extends by continuity of surface to the mucous membrane of the sac; or commences in the mucous membrane of the sac without previous disease of the palpe-

bræ : but in some cases it arises from inflammation in the subcutaneous tissue, and thence it extends to the sac ; and in others, which fortunately are now of comparatively rare occurrence, the disease originates in the bone, and the soft parts of the lachrymal passages become secondarily affected. This comparatively limited class may be said to be in a great measure confined to scrofulous persons, who have been affected by syphilis, and whose constitutions have been injured and rendered irritable by the injudicious employment of mercury.

Treatment.—In very mild cases, resolution is in the early stage often speedily obtained under the use of the antiphlogistic regimen, and of cold and evaporating lotions ; and in severe cases, suppuration is often averted by the employment of general depletion, purgatives, diaphoretics, low diet, together with local abstraction of blood by leeches, and the use of cold and evaporating lotions. When symptoms of suppuration appear, warm applications medicated with anodynes should be used, and as soon as matter is discoverable, the sac should be freely opened by a vertical incision commencing immediately underneath the tendo palpebrarum ; after which tepid water-dressings should be employed, and the parts syringed occasionally. By early, free, direct incision, structure may be saved and pain prevented.

DACRYOCYSTITIS CHRONICA, OR, CHRONIC INFLAMMATION OF THE
LACHRYMAL SAC.

This disease—the most common to which the lachrymal passages are liable—occurs at all periods of life, but not so often in childhood as at a more advanced age ; persons of a scrofulous habit are especially subject to it, and it is more frequent in females than in males.

Symptoms.—If the disease be chronic from the commencement, and not a result of acute dacryocystitis, and if it run its course, the principal symptoms are the following :

The first stage is characterized by a watery eye ; stillicidium lachrymarum ; weakness of the eye ; and impairment of vision from the accumulation of tears at the inner canthus. These symptoms are increased by using the eye, by looking at minute objects, or by exposure to cold and damp winds. There is slight redness, a feeling of uneasiness and fulness in the situation of the lachrymal sac, on pressing which the tears can be sent down through the nasal duct, and be made to regurgitate through the puncta : the tears are transparent, and not mixed with any muco-purulent secretion. The absence of muco-purulent secretion, the free passage for the tears through the nasal duct, and the power of completely emptying the sac by pressure, are characteristic peculiarities of this early period.

The next stage is attended with some increase of redness, of uneasiness, and of swelling ; the sac cannot be completely emptied by pressure, the nasal duct is generally obstructed, and the nostril dry ; and when the sac is pressed, tears and opaque muco-purulent secretion are seen to regurgitate through the puncta. This stage has received the name of *Blennorrhœa* (from *βλεννα*, *mucus*, and *ῥεω*, *fluo*), on account of the discharge of thick mucus along with the tears.

In the third stage, all the symptoms are of a more decided character ;

the swelling increases, matter forms, and makes its way by ulcerative absorption to the surface. This is the stage of suppuration, and ulcerative absorption.

After the discharge of the matter, the disease may subside, or it may again assume the characters of the previous stage called *Blennorrhœa*; or further collections may form, and make their way to the surface by fresh ulcerations of the parietes; or the disease may degenerate into true *fistula lachrymalis*.

In this disease a speedy cure is most desirable, not only for the same reasons which apply equally to other diseases, but also because, when it is of long standing, there is risk of the periosteum and bone becoming ultimately involved, constituting the condition called *carious fistula*. This risk is greater in scrofulous persons than in others. This condition of parts can be discovered by examination with the probe; but generally manifests itself by the offensive smell of the discharge, as well as by other symptoms common to all sores which are situated over bones affected with caries.

There are the same varieties as to the structures in which the disease commences in the chronic, as in the acute form of the affection; and here, also, the comparatively small class in which it originates in the bones, is composed chiefly of scrofulous persons who have become affected with syphilis, and been injured by mercury; and those in whom there is the greatest danger of the bones becoming secondarily affected, belong also to the same unhappy class.

Treatment.—To improve the general health by suitable treatment is, in all cases and in every stage, a most important indication. In the first and second stages, the principal points of local treatment are the occasional emptying of the sac by gentle pressure, local depletion by means of leeches, cold applications to the inflamed parts, the application of a gentle stimulating ointment to the edges of the eyelids at night, bathing the eye at times with astringent collyria, and cleansing the lachrymal passages occasionally by means of Anel's syringe. The last-mentioned proceeding is important in all cases, except when the action is very acute, or the nasal duct completely obstructed.

[When the lachrymal canals and sac are constricted by chronic inflammation, they are to be treated upon the same principles upon which strictures are treated in other mucous tubes. Bougies properly made and carefully used, will be as serviceable as bougies in stricture of the urethra. Many surgeons have been disappointed with Anel's probes for dilating these passages. But by means of a series of metallic bougies made of silver wire, from No. 25 to No. 15, and having the extremities made without bulbs, but of the same form as that of other bougies, we know that the punta, canals, and sac may be dilated sufficiently for a style to be introduced and worn.—Ed.]

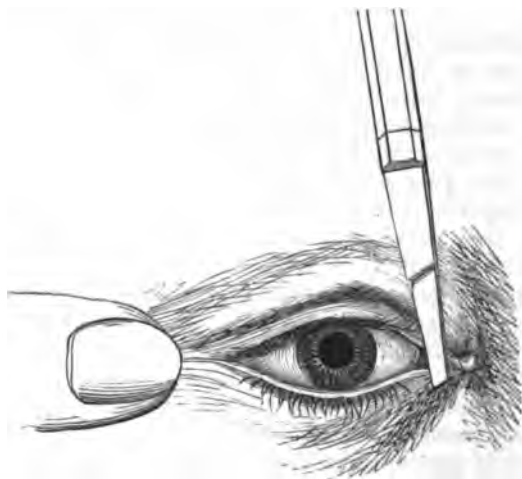
In the stage of suppuration, the use of warm applications and early and free incision constitute the proper proceeding. Here, as in the acute variety of this disease, both suffering may be prevented and texture saved by early incision; and no good can result, but much harm may, from delaying the adoption of this proceeding, after its necessity has become apparent.

FISTULA LACHRYMALIS, AND OBSTRUCTION OF THE NASAL DUCT.

The varieties with regard to the different tissues, in which the morbid action eventually terminating in fistula lachrymalis may originate, and the symptoms and anatomical conditions of that disease, may be clearly understood from what has been already stated. It is only necessary, therefore, here to remark that, although obstruction of the nasal duct may exist to some degree for a considerable time without fistula lachrymalis, yet it is always present in fistula lachrymalis, and indeed furnishes the condition which it is a paramount indication to remove, in order to cure the fistula; and that, although in the early stage, this obstruction may for some time depend on congestion and inflammation, without much or any organic change, and may in such cases yield to remedies for improving the general health along with the use of local depletion, stimulating ointments, astringent collyria, and some of the mildest forms of counter-irritation, yet in the more advanced stage it depends on organic changes caused by exudation into the submucous tissue, and the texture of the mucous membrane itself, and can be removed only by operation.

The only instruments necessary for the performance of this little, neat, and very satisfactory operation are, a narrow straight bistoury, a silver probe, and a style. The patient having been seated on a chair, the operator makes an incision in the common integument, at the under border of the tendo palpebrarum, and sends the knife into the lachrymal sac and the commencement of the nasal duct, by directing it downwards, very slightly backwards, and a very little inwards. The knife

Fig. 266.



is then withdrawn, and the probe sent down through the canal into the nose, and on withdrawing the probe, the style is immediately lodged in the canal, when the operation is finished. I have, in several instances,

dispensed with the use of the probe, and sent the style at once into the canal on withdrawing the knife. There are three simple directions, attention to which will enable the surgeon to perform this operation very quickly and neatly ; namely, to introduce the knife at the under border of the tendo palpebrarum ; to hold the several instruments as much in a vertical direction as the forehead will permit ; and in sending them downwards, to keep them slightly backwards and inwards, close to the mesial side of the lachrymal canal, which can easily be found, as it is immediately behind the ridge, on the nasal process of the superior maxillary bone. If these directions be attended to, the instruments cannot, unless force be used, be sent into any part except the lachrymal canal. The broad little head of the silver style rests on the common integument, and as it is made black, to a careless observer it looks like a little bit of black plaster below the inner canthus. The presence of the foreign body excites a degree of inflammation, in consequence of which the style ceases for a short time to be loose in the canal ; but this soon wears off, after which the style should be removed every day or two, and the canal cleansed by means of Anel's syringe ; and when the surgeon is perfectly satisfied as to the permeability of the canal, and the sound condition of its lining membrane, the use of the style may be discontinued. After this, the opening generally heals up without interference ; if not, the gentlest possible touch with nitrate of silver, or a hot wire, will promote occlusion. I have been much gratified with the result of this very satisfactory operation. To other modes of proceeding my limits will not permit me to refer.

CHAPTER XXII.

AFFECTIONS OF THE NOSE.

LIPOMA OF THE NOSE.

To a hypertrophied condition of the common integument and subcutaneous adipose tissue of the nose, the term lipoma of the nose is applied. These lipomatous enlargements of the nose seem to be restricted to the skin and subjacent tissue of the apex and alæ; which textures become thick-

Fig. 267.



ened and opened out. "The sebaceous crypts," Mr. Liston remarks, "are enlarged and distended with their secretion, some of them to a considerable degree, forming occasionally encysted tumours of the size of a garden pea; the cellular tissue is loaded with serosity, and in some cases there is evidently fibrinous deposit; the arterial capillaries are not much enlarged, though the veins on the surface sometimes are, giving to the tumour a blue and distended appearance, as when the part is dependent, or its circulation excited, or the return of blood prevented by

Fig. 267. From Liston.

violent exertion of the lungs, different parts become affected in succession, and the mass is made up of many growths from the point and sides, of various sizes, separated by fissures in which the sebaceous secretion lodges, often rancid and offensive." In lipoma of the nose, as in fatty tumours in other parts of the body, fatty tissue is the prevailing element. In normal fatty tissue there are vessels and fibres of areolar tissue in greater or less abundance between the true fat-cells; and the same is the case in lipoma. In some instances the areolar tissue is very sparingly found, whereas in others it abounds, forming tough fibrous partitions between the parcels of fatty cells.

Fig. 268.



The swellings are pendulous and loose, very insensible, slow in their growth, of a purplish or livid red appearance, as if produced by passive congestion; and, although unattended with pain, create discomfort and annoyance by interrupting vision, interfering with the functions of the nose, rendering it difficult to take food or liquid with comfort, disfiguring the appearance, and in some cases confining the breathing when the patient is in a horizontal position. Removal is therefore to be desired, and can be effected without danger or difficulty: the cicatrix becomes ultimately firm and depressed; and when completely removed, the swelling does not return.

Until of late, surgeons generally appear to have been deterred from interfering with these lipomatous swellings of the nose, probably from a dread of hemorrhage. Some good cases, however, are recorded, in which the late Mr. Hey of Leeds, Mr. Barlow of Blackburn, M. Civadier, and M. Thuelot, have performed this operation; and my late kind friend Mr. Liston operated on the patient from whom the accompanying sketches were taken. By the kindness of the publishers of Liston's "Practical Surgery," I am enabled to give these sketches; the first of which conveys an excellent idea of this disease in a very aggravated form, and the second, of the very satisfactory result of the operation.

Mr. Liston gives the following directions:—"An incision should be made through the diseased integument and cellular tissue in the mesial line, upon the cartilages of the apex and columna, not however so as to

Fig. 268. From Liston.

injure them; an assistant places his forefinger in one nostril, and the surgeon, seizing the mass either in his fingers, or with a small vulsellum, proceeds to dissect it off with a scalpel; the incisions must be carried close to the cartilages of the alæ, until the one side is cleared, the edge of the opening being well observed and not encroached upon. The assistant will give warning if the knife at any stage of the proceeding approaches his finger. The surface is trimmed a little, if occasion requires, with a thin, slightly curved or knife-edged scissors. A similar proceeding is observed on the opposite side, so as to make the part as symmetrical as possible." Any troublesome general oozing may be stopped by the assiduous application of pledgets of lint, moistened with cold water. When the discharge has ceased to be coloured, tepid water-dressings should be applied, and suppuration promoted.

POLYPUS OF THE NOSE.

Varieties.—The varieties of nasal polypi are, simple, cysto-mucous, fibrous, and medullary. Careful discriminations of these different affections is very important, both for prognosis and treatment.

SIMPLE POLYPUS.

Synonyms.—Simple polypus, simple mucous, mucous, common and gelatinous, are the names given to this mild and most common form.

Characters.—Simple polypi occur at all ages, but are most common at the middle period of life; they are seldom single, and rarely confined to one nostril; they grow from the investing membrane of the nostrils, and almost invariably from that portion of it which covers the superior turbinated bones; sometimes, however, especially in children, they originate from the part of the membrane which covers the inferior turbinated bone, but never from the septum. On two different occasions I found, at post-mortem examinations, polypi of this class origi-

nating from the mucous membrane covering the side of the nostril, immediately above the inferior turbinated bone. The patient has a constant sense of stuffing; preternatural discharge of mucus; a feeling of cold in the head; a frequent desire to blow the nose, and a difficulty in doing so; impairment or entire loss of smell, often also of taste; and at an advanced stage, when the tumour presses back upon the mouth of the eustachian tube, there may also be loss of hearing: then also speech is affected, becoming indistinct and snuffling. The symptoms are aggravated during damp



Fig. 269.

weather. After they have attained some considerable size, the polypi can be brought into view on blowing the nostril; they become so large as to fill up the whole of it, and often make the under part of the nose present a broad appearance, giving an unpleasant expression; but

Fig. 269. From Liston.

never, like some other polypi, cause separation of the bones. They are of a yellow gray colour, have little sensibility, produce no pain, and have very little tendency to bleed. Lachrymation is a common symptom in consequence of pressure on the nasal duct. Simple polypus sometimes projects into the pharynx, of which Mr. Liston gives the accompanying delineation.

Care must be taken not to mistake for this disease abscess in the nostril—projection of the septum to one side—general congestion of the mucous membrane—or hypertrophy of the inferior spongy bone. In every instance the nostril should be carefully explored by means of the speculum, a drawing of which is here given.

Fig. 270.



Valuable information will thus be obtained in doubtful cases as to the nature, form, and situation of the polypus; and also, after operation, as to whether or not the disease has been completely removed.

Fig. 271.



Treatment.—As a general rule it may be stated, that the best treatment is evulsion by means of a forceps. The blades should be applied to the neck of the polypus, which should be firmly grasped between them, and then by a gentle turn of the hand the polypus is separated and extracted.

Separation is effected not by pulling, but by twisting in one direction; in short, by one turn or twist of the hand. Care must be taken that it is the polypus only, that is between the blades of the forceps; and all violent efforts must be avoided, lest either the membrane or bones should be injured or detached. If hemorrhage should continue after some minutes, the nostril should be slightly plugged for a short time by introducing a long piece of lint by means of a blunt probe. The lint should, however, be withdrawn as soon as the tendency to oozing has ceased. Except in the very rare case of a single polypus, several operations are required before the nostril is perfectly cleared of the disease. This should be made known to the patient before the first operation, when extraction should be carried to such an extent, as to enable the patient to breathe freely through the nostril. Subsequent operations should take place in eight or ten days, that is, when the irritation of the previous one has worn off. After one or more of these operations, there sometimes appears to be a return of the polypi. Strictly speaking,

Fig. 270. From Liston.

however, this is not a reproduction of those which have been extracted, but the coming into view of some which had been confined in anfractuosities and narrow parts of the nostril, or the growth of others which had previously been kept pressed down, but which the removal of the cause of compression has left free to grow. When it is believed that the nostril is perfectly cleared, the tendency to return should be combatted, and a healthy condition of the lining membrane promoted by gently touching the part with nitrate of silver, and by the use of astringent lotions. When polypi are attached to the mucous membrane covering the inferior turbinated bones—which is very rarely the case, except in children—extraction is very safely effected by cutting the neck of the polypus with a pair of narrow probe-pointed scissors, while its base is held, and then brought out by means of a spring-forceps. In adults, also, these instruments are in some cases convenient for accomplishing extraction; but as a general rule, evulsion by the forceps is to be preferred.

CYSTO-MUCOUS POLYPUS.

This variety of polypus agrees so much with the former in form, in situation, in its attachment not extending deeper than the mucous membrane, in symptoms, in the mode and result of treatment, and in many other particulars, that it is only necessary to remark, that the colour is paler, that it does not present a uniform structure, but consists of various cysts filled with a mucous fluid, and that the parietes of the cysts are much more dense than the substance of simple polypus.

FIBROUS POLYPUS.

The peculiarities of this form of polypus were first pointed out by the celebrated M. Dupuytren, who gave it as his opinion that the fibrous polypus often degenerates into the medullary. This opinion has been also held by many other observers; but Professor Syme, whose experience in this department has been large, doubts its correctness, on the ground that medullary tumours in this situation exhibit their distinctive characters at a very early period, and that he has seen fibrous polypi retain their distinguishing peculiarities after they had been of long standing and had attained a great size.

The pain is severe; the texture of the polypus is firm, like that of fibrous tumour, of which this variety of polypus of the nose is a good example. It is most common in males between the adult and middle periods of life; it is pyriform, pendulous, hanging down into the throat; and is remarkable for its tendency to bleed, for the great size it attains; and for its attachment being to the periosteum, and not to the mucous membrane alone. Another point in which this variety differs from the former is, that the polypus is single. If not removed, it may prove fatal by hemorrhage, suffocation, or pressure on the brain. The principal peculiarities may be stated briefly to be,—attachment to the periosteum, rapidity of growth, great size, being single, great tendency to bleed, separation of the bones of the nose, and a much more aggravated character of all the symptoms than in the two previous varieties.

Treatment.—In this variety, the polypus very frequently hangs down into the throat. One mode of proceeding is, to seize the roots with the forceps, detach it from the periosteum, and press the polypus back into the throat. In this way the disease has in very many instances been completely removed. Another mode of proceeding very generally applicable to such cases is, to pass through the nostril into the pharynx, a double of silver wire, catgut, or whipcord, which last Mr. Liston recommends—to guide the double around the body of the polypus by the fore and middle fingers,—and then to draw the ends; this will send the double up around the neck of the polypus which is to be strangled by bringing the ends through a double canula, and fixing them tightly at its extremity.

Fig. 272.



From the accompanying wood-engraving, taken from Mr. Liston's "Practical Surgery," this proceeding will be clearly understood.

MEDULLARY POLYPUS.

Medullary, bleeding, and malignant, are the titles given to this perfectly incurable form of polypus. The principal distinctive characters are, that it usually occurs at the middle and later periods of life; that it commences in the bones of the nasal parietes: that its growth is in general rapid; that it is attended with great pain; attains a great size; and causes a separation of the bones of the nose, and in consequence, a very unpleasant expression of countenance; that it has a great tendency to bleed; and emits a very offensive bloody discharge; that it is always soft—so much so, that the forceps will often take away only the portion between its blades; and that, in addition to the usual symptoms of polypus in an extremely aggravated degree, the patient ere long exhibits the usual signs of malignant cachexy. In this, as in other malignant diseases, the only relief the surgeon can give, is to palliate the

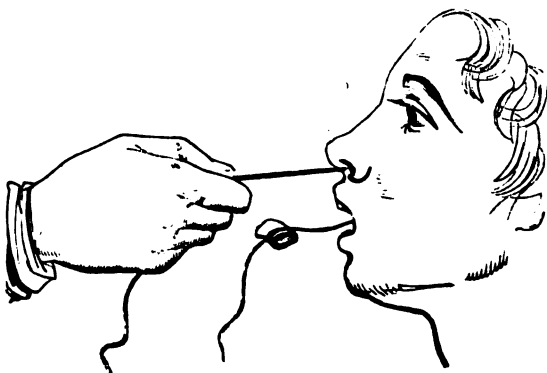
Fig. 272. From Liston.

most urgent symptoms ; and with regard to local interference, there can be no doubt that it is exceedingly desirable, if possible, to avoid it altogether, as patients are likely to live longer if nothing be done. Sometimes, however, to prevent suffocation, portions of these tumours are cleared away ; but cases not unfrequently occur, in which the least interference causes so much hemorrhage and irritation, that even this proceeding, for the relief of an extremely urgent symptom, cannot be resorted to without great danger. The language of one of the greatest surgical authorities in regard to these tumours in the nose, is, "Such growths, when they present in the nostrils, are perfectly irremediable and uncontrollable by any surgical proceeding."

OPERATION OF PLUGGING THE POSTERIOR NOSTRIL.

The principal remedies for arresting spontaneous epistaxis are, perfect quiet, abstraction of stimuli, and the internal use of gallic acid, elevation of the head, local application of styptics, compression of the nostrils, and the methodical introduction of lint through the anterior opening of the nasal fossa. It is very seldom that the last-mentioned proceeding has not the desired effect ; but when the above remedies are not successful, it is necessary to plug the posterior nostril. This may be readily accomplished by sending a piece of silver or other wire, or of catgut, with a ligature fixed to it, along the floor of the nostril, into the

Fig. 278.



throat ; bringing one end of the ligature through the mouth, by taking hold of it with a forceps when seen in the throat, and the other through the nostril, by drawing out the wire. The most convenient mode of introducing the ligature, however, from the nose to the throat, and for bringing back one end through the nostril, is the exceedingly suitable instrument contrived for the purpose.

To the portion of ligature coming through the mouth, a bit of lint proportioned to the size of the posterior nostril is attached, and by drawing the nasal extremity of the ligature, and guiding the plug behind the

Fig. 278. From Liston.

velum pendulum palati, it can be lodged in the posterior nostril. This being done, the anterior nostril should be methodically filled with a long narrow bit of lint, when the hemorrhage will be completely commanded.

RHINOPLASTICS.

Restoration of the whole nose is now performed as follows: The cicatrized remains of the old nose having been pared down to a considerable depth, so that the edges and the whole surface are made raw—to which a flap borrowed from the forehead is to be applied—a piece of soft leather, shaped of the size required to form the apex and alæ, is placed on the forehead, with the narrow part between the eyebrows, and the broad part upwards. The outline of the flap having been marked with ink or with a knife, the flap is dissected down, care being taken to make it of uniform depth, and not to interfere with the pericranium. The neck of the flap should be made sufficiently long to admit of its being turned round without injury to the circulation, and to facilitate this turning round, it is advisable to make the incision a little longer on the side to which the twist is to be made. Bleeding having ceased, the flap should be turned round, and its edges, after being carefully adjusted to the margins of the remains of the former organ, secured by sutures; a little oiled lint is placed in the nostrils to support the flap, and no further dressings are applied to the part. The edges of the wound in the forehead at its lower part are brought together by a suture, and the remaining part treated with tepid-water dressings to promote granulation.

The organ having become consolidated, restoration of the columna may be accomplished by the following operation, recommended by Mr. Liston, and practised by him with great success.

“The inner surface of the apex is first pared. A sharp-pointed bistoury is then passed through the upper lip, previously stretched and raised by an assistant, close to the ruins of the former columna, and about an eighth of an inch on one side of the mesial line. The incision is continued down, in a straight direction, to the margin of the lip; and a similar one parallel to the former, is made on the opposite side of the mesial line, so as to insulate a flap composed of skin, mucous membrane, and interposed substance, about

Fig. 274.

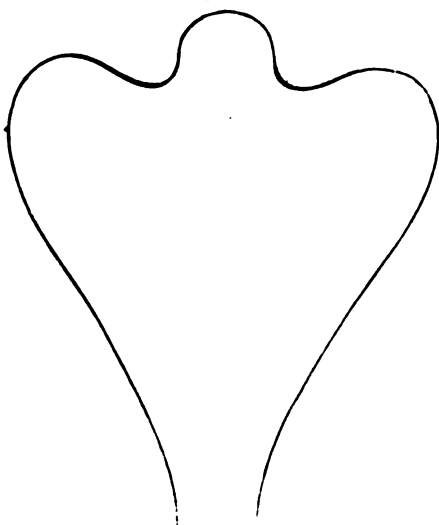


Fig. 274. From Liston.

a quarter of an inch in breadth. The frænulum is then divided, and the prolabium of the flap removed. In order to fix the new columna firmly and with accuracy in its proper place, a sewing-needle—its head being covered with sealing-wax to facilitate its introduction—is passed from without through the apex of the nose, and obliquely through the extremity of the elevated flap: a few turns of thread suffice to approximate and retain the surfaces. It is to be observed that the flap is not twisted round as in the operation already detailed, but simply elevated, so as to do away with the risk of failure. Twisting is here unnecessary, for the mucous lining of the lip, forming the outer surface of the columna, readily assumes the colour and appearance of integument, after exposure for some time, as is well known. The fixing of the columna being accomplished, the edges of the lip must be neatly brought together by the twisted suture. Two needles will be found sufficient, one being passed close to the edge of the lip; and they should be introduced deeply through its substance; two-thirds at least of its thickness must be superficial to them. Should troublesome bleeding take place from the coronary artery, a needle is to be passed so as to transfix its extremities. The whole cut surface is thus approximated; the vessels being compressed, bleeding is prevented; and firm union of the whole wound is secured. The ligature of silk or linen, which is twisted round the needles, should be pretty thick and waxed; and care must be taken that it is applied smoothly. After some turns are made round the lower needle, the ends should be secured by a double knot; a second thread is then to be used for the other needle, and also secured. With a view of compressing and coaptating the edges of the interposed part of the wound, the thread may be carried from one needle to the other, and twisted round them several times; but in doing this, care must be taken not to pull them towards each other, else the object of their application will be frustrated, and the wound rendered puckered and unequal. Last of all, the points of the needles are to be cut off with pliers. No further dressing is required. As previously remarked, no good end can be answered by any application, and the separation of dressing may afterwards be troublesome; discharges from the neighbouring passages are retained by it, foetor is produced and union interrupted. The needles may be removed on the third day; their ends are cleaned of coagulated blood, and, after being turned gently round on their axis, they are to be cautiously withdrawn, without disturbing the thread or the crust which has been formed about them by the serous and bloody discharge. This often remains attached for some days after removal of the needles, and forms a good protection and bond of union to the tender parts. Some care is afterwards required from the surgeon and patient in raising the alæ, by filling them with lint, and thus compressing the pillar so as to diminish the œdematous swelling which takes place to a greater or less degree in it, and to repress the granulations. It is besides necessary to push upwards the lower part of the column, so that it may come into its proper situation; and this is done by the application of a small round roll of linen, supported by a narrow bandage passed over it and secured behind the vertex.

“Independently of the great improvement produced on the patient's

appearance by the restoration of the lost part of so important a feature, it may be observed, that, when the columna has been destroyed, the lip falls down, is elongated, and becomes tumid, particularly at its middle, so that borrowing a portion from it materially ameliorates the condition of the part; and the cicatrix being in the situation of the natural fossa, is scarcely observable."

AFFECTIONS OF THE ANTRUM.

The antrum is not unfrequently the seat of collections of matter of various kinds, and sometimes of polypi. It is not unfrequently occupied with a fluid of a clear and glairy appearance. Some remarkable examples of this class are recorded, and two have come under my own observation. In cases of this nature the fluid is sometimes slightly puriform, and very often resembles in appearance the fluid found in cysts in other parts of the body. The walls of the cavity become expanded, attenuated, and in some cases so thin as to crackle on pressure. Collections of this nature are not attended with symptoms of the inflammatory process.

The antrum is also subject to acute and chronic abscess; but the former rarely occurs, except in consequence of violence applied to the bone, or of very acute disease in the teeth or gums. In all such instances the grand indication is, to make early, free, and dependent opening for affording complete evacuation and preventing reaccumulation. If the canine or one of the molar teeth be diseased, it should be extracted; the matter often escapes through the empty socket, and it is a frequent practice to enlarge this communication by sending a trocar through the empty socket into the antrum; but the more effectual mode of procuring evacuation and preventing reaccumulation is, to make an early free opening by dividing the membrane of the cheek and the attenuated parietes immediately above the molar teeth.

The antrum is very rarely the seat of any kind of polypus, except the malignant, which is, of course, as irremediable here as it is in the nostril. It is of great consequence not to confound this affection or osteocephaloma of the jaw with osteosarcoma; the former being certain to prove fatal, and the latter as certain to be cured by excision of the upper jaw,—an operation described in the chapter on resections of bone.

CHAPTER XXIII.

AFFECTIONS OF THE MOUTH, THROAT, AND WINDPIPE.

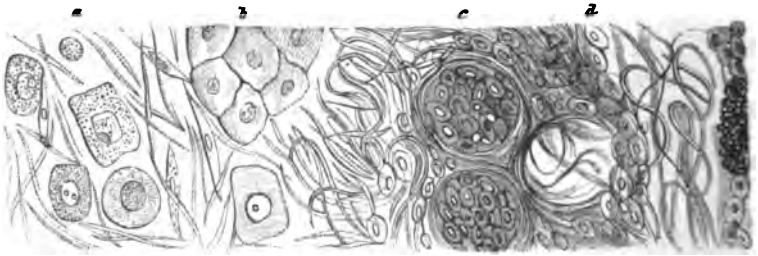
AFFECTIONS OF THE MOUTH.

CANCER OF THE LIP.

THIS disease is almost entirely confined to the under lip. I have never seen it in the upper lip as a primary affection, and very rarely, indeed, as an extension from the lower; and it is well known that such extension seldom takes place. The greater liability of the lower lip to this disease is supposed to arise from its being much more exposed to irritation on account of its situation and mobility. This affection is more frequent in males than in females, and like all others of the same class, is more common after than before the middle period of life. Very lately, however, in the Royal Infirmary, I removed a scirrhus tumour from the lip of a female under twenty years of age. In that case the common and microscopic characters of carcinoma were exceedingly distinct.

The disease may originate in a carcinomatous tumour in the lip, over which the skin or mucous membrane at last ulcerates, so that a cance-

Fig. 275.



rous sore is constituted; or in a warty excrescence, which degenerates into cancerous ulceration; or in a superficial chaf, ulcer, or excoriation. The form of the disease is the scirrhus variety.

There is an affection, however, very common in the lip which differs from cancer, and is considered an epithelial formation, consisting principally of hypertrophy of some of the natural tissues of the lip. A

Fig. 275. Appearance of section of cancerous tumour of the cheek. *a.* Epidermic scales and fusiform corpuscles on the external surface. *b.* Group of epidermic scales. *c.* Fibro-elastic tissue of the dermis. *d.* Cancer cells infiltrated into the fibrous tissue, and filling up the loculi of dermis.—(From Bennett.)

respected authority gives as the result of numerous microscopical observations on this subject the following remarks :—

“The *papillæ* of the *cutis* were hypertrophic, and very considerably lengthened. Whilst upon the whole surface of the *papillæ* a plaster of epithelial cells had been formed, which continually grew, and were thrown off as scales ; so was each *papilla* surrounded at its extremity with a thick sheath of *epidermis*, and thus a cylinder was formed into which the base of the *papilla*, often capable of being drawn like a thread out of its sheath, entered. These cylinders, at first close to each other, were pushed apart by the scaling, though still held together on the surface by a layer of epidermal scales. In many cases the epithelial formation was very great, and presented an appearance nearly allied to warts and condylomata.”

Such is the description given by Earle of this disease, which he has described as hypertrophy of some of the natural tissues of the lip. This is the disease described by Professor Bennett in his valuable work on “Cancerous and Cancroid Growths,” under the name of Epithelial Growths, which he refers to the class of cancroid growths, using that expression in the sense affixed to it by Lebert, namely, to denote those tumours which more or less resemble cancerous tumours, and are constantly mistaken for them, but do not correspond with them in structure ; and limiting the term cancerous to those growths which exhibit the characteristic peculiarities of that disease. Professor Bennett remarks, “These growths generally commence by an induration or wart upon the skin or mucous surface. In the former position they are generally harder than in the second. Sometimes they constitute cauliflower excrescences or condylomata, made up of elongated papillæ, aggregated together, with their summits more or less flattened. In this condition their diagnosis is generally easy. At other times, sooner or later after their formation, they soften externally, and become covered with crusts of inspissated pus and epithelium. This, on separation, becomes an ulcerated surface, presenting irregular clefts or depressions between the hypertrophied papillæ, the edge is everted, and the base and margins gently indurated. The ulcer may slowly spread over a considerable portion of the surface, and cause great swelling of the lymphatic glands from the irritation produced. In this condition such ulcers are usually considered to be cancerous. The progress of an ulcer, commencing externally in warty excrescences spreading laterally, slowly, and proceeding from without inwards, is directly opposite to the progress of cancer, which almost invariably commences deep-seated, produces ulceration secondarily by thinning of the integument, and throws out subsequently and rapidly fungoid masses. Hence the progress of the case is often diagnostic. This, conjoined with the microscopic examination of the projecting papillæ, and the absence of cancer cells, will in most cases sufficiently establish the nature of the disease.” For much interesting information regarding epithelial cancroid growths, the reader is referred to Professor Bennett’s admirable treatise on “Cancerous and Cancroid Growths.”

The lip is liable to various ulcerations of a simple, syphilitic, or other nature, which prove obstinate from the constant motion of the part,

and the irritation caused by the fluids of the mouth. These may generally be distinguished from cancer of the lip, by the absence of the characteristic peculiarities of cancerous ulceration, the history of the case, and their usually being amenable to proper general and local treatment. The microscope, moreover, will afford conclusive evidence whether the tumour be cancerous or not, if a minute portion be removed and examined under it.

Fig. 276.



Treatment.—The proper proceeding is the entire removal of the mass by excision at the earliest possible period. When the disease is confined to a moderately narrow space, the lip is seized by the forefinger and thumb of the left hand, and drawn out from the gum.

Two straight converging incisions are then made downwards with a sharp bistoury so as to meet in a point below, including the whole diseased part along with a small border of sound tissue in the triangular or V-shaped piece, which is thus removed. I generally perform the excision with a single stroke, employing for that purpose a very narrow straight bistoury, which being carried down one side admits of being rapidly turned at an acute angle, after which it is brought up on the other aspect of the tumour. By this method excision can be very rapidly accomplished, and, by using a very narrow knife, the angle at the bottom of the wound can be made as sharp as by the usual methods of making two distinct incisions both carried downwards, or of making one incision by transfixing, and the other by cutting downwards. Before the operation is commenced, the angles of the mouth may be compressed so as to prevent the flowing of blood from the coronary arteries during its progress; or the same purpose may be effected by pressing on the facial artery, on each side as it runs on the groove at the union of the middle with the posterior third of the base of the inferior maxilla.

The wound is treated afterwards as in cases of hare-lip, and the necessity of tying bleeding vessels is obviated by making the needles of the twisted suture transfix those points from which blood would otherwise flow in any quantity. When the disease affects the greater part or the whole of the breadth of the lip, it may be removed in a slice by a crescent-shaped sweep of the knife; after which the margins of the skin and mucous membrane may be approximated and kept together by the smallest form of the little spring forceps mentioned in the chapter on Wounds as being employed for such a purpose in Paris. In the absence of this little instrument, one or two points of the interrupted suture may be employed, but much less advantageously. The crescent-shaped slicing of the lip is best adapted for those cases in which a considerable breadth, but only a small depth, of the lip is implicated. When the disease extends far down as well as laterally, the triangular excision should be practised, and the operation completed by Professor Syme's proceeding for the restoration of the lower lip.

Fig. 276. From Liston.

HARE-LIP.

Hare-lip is the name applied to the condition in which one or more fissures exist in the upper lip. It is usually congenital, and caused by arrest of development; but it may be induced accidentally by wounds. The fissure, when single, is usually in the central line, though sometimes it is situated a little towards one side: when there are two fissures, they are generally placed below the apertures of the nostrils; and in this case the central portion of the lip may be either of the full length, or, as is more usual, merely a short rounded process. A mesial portion of the superior maxillary bones frequently projects forwards, more especially in double hare-lip. Cleft palate is a frequent accompaniment of this condition.

Hare-lip, when very slightly marked, may not much impede the child's sucking; but when it is to a greater extent, it may very much interfere with it—nay, even render it impossible.

The best time for an operation for the removal of this deformity is, when most of the temporary teeth have come through the gums: this is the time usually preferred by the surgeon, when it rests with himself to decide; but when parents are unwilling to have the operation delayed, he performs it before the commencement of dentition. It has, however, been done with perfect success, and without any unpleasant results, at all ages, from two months upwards; but it is not desirable, and certainly it is not necessary to operate earlier than three or four months after birth, as the operation can be well done at a later period, and no bad consequences are caused by delay.

When a simple fissure exists without malformation of the upper maxilla, it may be rectified in the following manner:

A towel, or large cloth, having been wrapped round the child, so as completely to secure its hands and feet, and prevent all struggling, it is placed on the nurse's knee with the head secured between the surgeon's knees. He then seizes the lower corner of one side of the fissure, between the finger and thumb, and sends a sharp, narrow, straight-bladed bistoury through the lip, immediately above the apex of the hiatus, with its edge directed straight downwards; the blade is then slightly turned so as to direct the edge a little outwards, and is brought down, cutting off a thin slice from the edge of the fissure. The opposite corner of the lip is next seized, the bistoury is introduced at the same point, and is made to cut off a similar slice from the other side. In a central fissure these two incisions, though smooth and uniform, should not be exactly straight; they should, as Professor Syme recommends, be very slightly curved with the convexity directed outwards, so that, when the margins are approximated, the natural fulness of the prolabium at this point may be preserved. Without this little precaution there usually remains a notch in the lip, which is unseemly, however small.

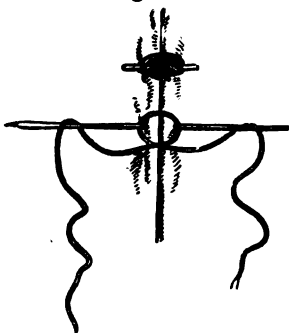
Fig. 277.



Fig. 277. From Liston.

Approximation of the clean cut edges having been effected, one or two common sewing needles of suitable size, and provided with a knob of sealing-wax on the head to serve as a handle, or needles with spear points, or pins with spear points, both of which are made expressly for this operation, are introduced so as to transfix both margins, passing through about two-thirds of the thickness of the lip, but not penetrating the mucous membrane. Their points are broken off with a forceps, and a waxed ligature is then twisted in the form of the figure 8 around their extremities, which emerge from the integument at a little distance from the margins of the wound on each side. Each needle is supplied with a separate ligature; because if the same thread be continued from one needle to the other, puckering of the wound between the two is apt to be produced. No dressing whatever should be applied over the wound.

Fig. 278.



In this operation it is of great importance to have the edges evenly and uniformly cut, meeting at a sharp angle above, so as to facilitate accuracy of coaptation. The sharpness of the bistoury, and its being narrow-bladed, will contribute much to the accomplishment of both these ends. One of the needles may be removed in two or three days, by gently twirling it round as it is withdrawn, the wax thread rendering this manipulation easy: the other may be taken away two days afterwards, or in many cases even sooner; but the twisted threads which have been soaked in the oozed blood, and in drying have become strongly adherent, may be left undisturbed for several days longer.

A double fissure, without malformation of the upper jaw, is treated on similar principles. The lip, if tightly adherent to the gum, is

Fig. 279.



Fig. 280.



loosened sufficiently by cutting the mucous membrane. Then, if the central lobe between the two fissures be of full breadth and length down to the prolabium, the margins of both fissures are pared, forming two complete and separate lines of wound; but if the central portion

be short and rounded, it is sliced so as to bring it to a point at the bottom, as is represented in the accompanying wood engraving, and the margins on each side being also pared, are brought together, embracing this little part above, but coming into contact with each other below. In both cases the same needles serve for both slits, being made to transfix the central piece without appearing on its surface, and emerging on the skin a little beyond the outer edge of each fissure. The threads are wound around as before. In all cases it is preferable to operate on both sides at once, and not to make two operations at different periods.

When there is malformation of the upper jaw, so that it projects slightly in the centre, the case may be treated without any peculiarity of proceeding; for the steady yet gentle pressure of the united lip, as I have often seen in cases coming under my own observation, gradually depresses the prominent piece of bone, at least in young children. But if it project so much as to prevent the possible closing of the fissure over it, it may generally be pressed back by a suitably contrived spring pad, which is kept applied with a gentle degree of pressure for a few hours daily during some weeks, after which the operation may be performed. This is preferable to snipping off the piece of bone with the forceps, a proceeding very rarely indeed necessary in these cases. When any teeth project very much forward, they should be extracted previous to the operation, as the irritation caused by them would be apt to prevent adhesion. In order to prevent the needles from keeping up a strain and tension of parts in cases where the fissures are very wide, which might lead to their being set free by ulceration, and thus produce return of hare-lip, several varieties of apparatus have been employed to press the cheeks forwards towards the mesial line. The best for this purpose is the apparatus employed by Mr. Fergusson, and described in a late number of the "*Medical Times*;" it consists of a spring, forming the greater part of a circle, with a soft pad affixed to each extremity, and a strap to prevent the apparatus from falling too far down; the pads being directed forwards, and intended to press in the cheeks and prevent their retraction, after they have been drawn forwards by the fingers of an assistant. By using this apparatus, and by attending to a most important point, namely, the free division of the mucous membrane when necessary, so as to liberate the soft parts from the bone, and admit of their being brought forward, the worst possible deformity of this nature is capable of being perfectly cured.

RESTORATION OF LIP.

Restoration of a lip is an operation occasionally demanded; in some cases merely to prevent deformity, in others to remove more serious inconveniences, such as imperfect articulation, and a constant flow of saliva outwards.

The *upper* lip is but little subject to disease, though exceedingly liable to congenital fissures. These, however, are usually so narrow that their sides can be approximated without difficulty. But if the operation for hare-lip be performed several times on the same individual, and as often fail, the repeated paring of the edges, and the ulceration which sets the needles free, destroy the lip to such an extent that it may

be impossible again to bring the parts together without incurring one or other of the following consequences,—either the commissures of the mouth will be dragged inwards so as nearly to meet under the columna of the nose; or, if the apposition be partially effected at the upper angle of the fissure, the free border of the lip thus left will be composed of the irregular margins which *ought* to have formed a direct continuation of the vertical junction above, and not a line obliquely transverse to it; and its rounded corners, at the point of union in the centre, will leave a retiring angle, sufficient still to afford to the lip a decidedly leporine appearance.

When the upper lip has been destroyed in this manner, Mr. Syme restores it by the following method. After paring evenly the edges of the gap, which resemble the limbs of the capital A set very widely, or at an obtuse angle, he makes an incision about an inch and a quarter long, or about the same length as the pared border, across each cheek, outwards and a little upwards, in the direction of the zygoma. These four incisions resemble a widely-printed W. The margins of the central gap can now be readily approximated, and secured in the usual way by the twisted sutures. A stitch of the interrupted suture may be required at the outer part of the lateral incisions, the upper margins of which, being drawn inwards, chiefly form the prolabium, while the natural elasticity of the integument prevents the injurious straining of this edge, or the rough corrugation of the lower border.

The *lower* lip, much more frequently than the upper, requires to have a large portion removed, when the intractable or malignant affections, to which it is so liable, have been allowed to pursue their course for a considerable period. Here the gap is generally of more formidable dimensions, and is more inconvenient than even an extensive fissure of the upper lip, as there is in this case greater difficulty in restraining the outward flow of saliva.

Professor Syme has successfully restored the deficiency by the following operation.

A triangular excision of the diseased mass having been made, two straight incisions are carried from its apex downwards and outwards *nearly* in a continuous line with the cut margins of the V-shaped hiatus, forming thus far the letter X. Each of these lower cuts is finished off by being continued outwards for a short distance in a curve, the convexity of which is directed downwards, and its free extremity turned upwards. The flaps thus formed are detached from their underlying connexions, as far outwards as the extremities of the gaps above, and of the curved prolongation of the downward incisions below. The obliquely-placed V margins, from which the diseased tissue has been cut, can now be made horizontal by raising their inferior internal angles, forming thus the free border of the new lip; the outer edges of the straight parts of the incisions, which were carried obliquely downwards and outwards, become by the same movement vertical, and are brought into mutual apposition; and the curved portions immediately below and outside accommodate themselves along the sides of the triangular tongue of integument, from contact with which the straight margins of the incisions have just been elevated. The elasticity of the skin prevents any

undue straining or unseemly corrugation, which might otherwise have occurred in the adjustment of these curved lower parts of each incision.

The twisted suture is employed to retain in coaptation the vertical line of union thus effected, from the border of the lip down to the point where the two lateral parts of the wound branch off. The lower of the three or four needles required for this purpose should also transfix the apex of undetached skin which occurs at this last point. About the same number of stitches of the interrupted suture are then inserted, to connect the edges of each of the two diverging incisions below.

Professor Serre of Montpellier has suggested and practised a method of forming a new lower lip, presenting the advantage of being lined by a mucous membrane. This consists in making two incisions, one from each end of the lip downwards, which meet in the mesial line a little above the pomum Adami. Other two incisions are then made horizontally from the angle of the mouth to the borders of the masseter muscles in a line with the teeth of the upper jaw, and below the level of the parotid duct. These two latter incisions extend through the whole thickness of the cheeks. The flaps included between the incisions on each side are then carefully separated from the subjacent parts, and the margins brought together and retained by hare-lip pins and twisted sutures. The integument and mucous membrane are then also brought together at the edge of the new lip by means of a few simple sutures. In the "Medical Times," for January 3d, 1852, an account will be found of a case in which Mr. Lawrence performed this operation in St. Bartholomew's Hospital; the only instance, so far as I know, in which Professor Serre's operation has as yet been performed in this country.

FISSURE OF THE PALATE.

Congenital Fissure affects sometimes the uvula merely; sometimes the whole velum palati, the hard palate being entire; sometimes the bones alone, the velum being entire; sometimes the velum palati and bones, as far forward as the alveolar process, in which case the fissure is invariably in the mesial plane; and sometimes the velum palati, the hard palate, and alveolar arch,—a case in which the fissure, if single in front, diverges a little to one side, where it goes through the arch, but if double, the state of the palate resembles the outline of the letter Y; sometimes, also, the fissure of the whole palate is combined with hare-lip.

Extensive fissure causes great difficulty in sucking, as the food in being swallowed passes through the nostrils; it also causes great impediment in articulation, rendering it exceedingly indistinct and disagreeable.

When fissure of the palate is combined with hare-lip, the first proceeding should be to remove the latter deformity; this having been effected, the velum palati, if the fissure be not of very great breadth, should be made the subject of operation; after which the hard palate should be covered by a plate. For fissure of the hard palate alone, the patient must wear a plate properly prepared and fitted by a dentist: and for fissure of the soft palate, the operation of staphyloraphy, or velo-synthesis, is resorted to; an operation practised by Roux, Graefe, and

others, but brought to its present greatly improved state by Professor Fergusson of King's College Hospital, who may be said to have proposed a new mode of Staphyloraphy, the principle of which is, to divide the muscles that draw the flaps from each other and widen the fissure; by this means the velum is put into a state of repose, and the pared edges are in less danger of being pulled asunder during the process of union. Professor Fergusson commences operative proceeding by dividing the levator palati and palato-pharyngeus muscles, and in some cases the palato-glossus.

To give the reader a complete account of this interesting operation, and also of the considerations which suggested this new and very useful proceeding to the Professor's mind, I think it advisable to give his own remarks, as they appeared in the "Medical Times," for March 6th and March 18th, 1847.

"It had long been familiar to those accustomed to see such cases in the living body, that during deglutition the two portions of the uvula came together in the middle line; but no one had attempted to explain how this could happen, and even such an acute observer as M. Malgaigne stated, that it was 'by a muscular action, of which it is difficult to give an explanation.' The dissection of the parts enabled me to explain this in a way which I imagine is incontrovertible; and to show you how this happened, as well as for other purposes, it will now be best that I should explain to you the condition of the parts in this malformation, and contrast it in as far as may be requisite with the natural state.

"The preparation now before you exhibits the upper part of the mouth and pharynx of an aged female subject. The muscles of the pharynx have been carefully dissected, as have also those connected specially with the palate. A glance at the roof of the mouth shows the gap in the mesial line, and how the uvula, soft palate, and a portion of the hard, are involved in the defect. Behind it may be observed that the constrictors are not so broad, so capacious, as in the natural condition, but that the muscular fibres are nevertheless as strongly developed. The upper border of the superior constrictor is especially well marked, and here it may be seen to form a kind of semicircular margin, extending between the basilar process of the occipital bone and the internal pterygoid plate, on which margin the levator palati muscle seems to rest. A perpendicular incision has been made through the pharynx behind, exactly in the mesial line, and, the mucous membrane having been stripped off the inside, the muscularity is thus rendered still more distinct. The mucous covering has also been taken off the upper surface of the palate, whereby one side of the nostril immediately above, and the muscles of the palate, have been more extensively exposed.

"It may now be seen how the two portions of the uvula and corresponding parts of the soft palate touch each other during deglutition, for it is evident that, as the superior constrictor muscles act, they must throw or push the soft tissues in front forwards and inwards;—an effect which will be aided by the superior fibres of the middle constrictors, which, stretching across as they do from one side to the other, having no attachment mesially, as is also the case with the lower fibres of the superior muscles, must contribute powerfully to the result in question. A

remarkable difference may here be observed between this and the normal state of the parts: the palato-pharyngei muscles are not attached to each other, as in the well-formed palate. These muscles are seen to form the principal part of the free margin of the palate along the line of fissure; their course is somewhat semicircular from their upper end to their lower, the convexity being towards the middle; and it follows, that, during action, if not opposed in any way, they must pull the parts outwards—an action the reverse of that described by Dzondi, Müller; and others, as belonging to the muscles in their natural condition. The levator palati is seen throughout its entire course, and the tensor palati may also be clearly made out. The levator, it will be perceived, as I imitate its action by pulling it, not only acts very efficiently on the movable portion of the palate, but its sphere of action, from the muscle being chiefly muscular throughout its entire course, is so great that, during rigid contraction, it must forcibly pull the soft parts upwards, backwards, and outwards. It is worthy of special observation, that the tensor or circumflexus palati has hardly any influence on the velum, for, pull as I choose upon it, there is only the slightest movement to be observed at the parts where its tendon spreads on the surface of the soft palate. Neither in the natural nor in the cleft palate can this muscle have a power at all to compare with the levator, which, from its length, position, and character generally, is the principal motion of this very mobile part. The anterior pillar of the fauces is very slight, and the fibres of the palato-glossus are indistinct; the posterior pillar, however, is distinct enough, and formed as in the natural state by the bundle of fibres of the palato-pharyngeus. The azygos uvulæ is by no means distinct; a bundle of fibres, about the size of a crow-quill, may be seen on the lower part of each free margin of the soft palate.

“From such an inspection as this preparation afforded, I was led to take those views of the physiology and surgery of the parts, the explanation of which forms the principal object of this lecture. It required no great foresight to perceive, that the movement of each side of the palate must depend chiefly upon the action of the levator muscle and palato-pharyngeus. The influence of the levator muscle might have been calculated on from previous knowledge, but that of the palato-pharyngeus could scarcely have been thought of. Both must evidently have been the effect of widening the fissure, especially the levator; and the various conditions under which the palate may be seen can be explained by reference to these two muscles. When the mouth is looked into, and the soft portions of the palate are in a quiescent state, the fissure will then appear probably in a medium state. A slight irritation, with a probe or point of the finger, will cause a corresponding movement—the soft parts will be drawn upwards and outwards, so that the gap will be enlarged. If the irritation be increased, the same parts will be so acted on that they will almost disappear on the sides of the fissure, but even now, if an effort at deglutition be made, the two portions of the uvula will be forced together, by the action of the superior constrictors, as already explained. It seemed to me that under ordinary circumstances, after the operation for closing the fissure, the slightest irritation would be likely to call the levatores and palato-

pharyngei into action, and so induce that dragging on the stitches with which surgeons were so familiar—an influence sufficient, in some instances, to cause ulceration in the seat of the threads, or, in others, to cause separation of the recently-united parts. I therefore supposed that, if these muscles could be divided before bringing the edges of the palate together, the parts would remain so quiet immediately afterwards that there would be greater probability of union in the mesial line taking place than if the muscles were left entire or untouched. It was not long before I had an opportunity of testing the project on the living body. The result was so satisfactory that I tried it in another instance shortly afterwards, and here the effect was most complete. The two cases were appended to my paper on this subject when laid before the Royal Medico-Chirurgical Society, and since that date I have operated on eight more, making ten in all, in eight of which I have been perfectly successful in closing the soft palate. In some of these there has been fissure of the hard palate as well, and the parties have been content with the remaining comparatively small apertures, or have had them closed by obturators. I know of four other instances, where the operation, conducted on the plan recommended by me, has been successful, and a fifth which failed. During the same period I have known three examples of failure by the ordinary method. Thus, out of fifteen cases on my plan, there have been three which did not succeed, while all those done in accordance with Roux's operation were failures.

“There are cases of cleft palate with which it would be unreasonable to meddle, the gap being so large and the soft tissues so narrow, that union could not possibly be anticipated. It has been supposed that when the two portions of the uvula are observed to touch each other during deglutition, the operation may invariably be undertaken; but the fact is, that in almost all instances these two parts touch at this particular time, however large the fissure may be, and it is better to be guided in deciding upon the propriety of an operation by the condition of the parts otherwise. In most cases where the osseous palate is open, there will be less certainty of a favourable result than if the soft velum alone were implicated. If it seems that only a small portion of the fissure in the soft parts can be closed, it will, perhaps, be best to leave the parts alone, and to trust for improvement entirely to an obturator or false palate, for it has sometimes been found that when there has been union only to a small extent, the condition has interfered with the proper adaptation of the apparatus.

“The operation should seldom be undertaken until the patient has reached puberty. Much steadiness and self-command is required on his part, both during the operation and afterwards; and it is hardly to be expected that one under this age will have the fortitude to do what the surgeon expects of him. I have, in one instance, seen a youth of eleven years of age comport himself admirably during the operation; but any time between sixteen and four-and-twenty is that which should be preferred.

“The mode of proceeding which I generally follow may be thus described:—the patient should be seated on a firm chair with his face to the light; the surgeon should stand a little in front, on the right

side, and occasionally behind the patient. In this latter position he may see into the mouth by leaning over the face, and use his fingers with more satisfaction and facility than if he were always in front, for here he is apt to obstruct the light, and possibly fatigue his hands by holding them so long in an elevated position towards the roof of the mouth. I make an incision about half an inch in length, a little above the free margin on each side of the cleft, whereby the levator palati muscle is divided. The knife is sharp at the point, and also at each side, so that it may be readily passed through the mucous membrane, and carried backwards and forwards to enlarge the wound to the requisite extent. The point of the blade is entered above the middle part of each soft flap, where there is the greatest thickness of tissues, and, whilst it is carried deep against the levator muscle, it is moved as just directed, and not withdrawn until the power of elevating the part seems to be done away with. If, when the knife is withdrawn, there should still appear strong muscular action in an upward direction, as may be ascertained by irritating the parts, it may be used again, as possibly the whole of the muscle may not have been cut across. All this can be best done whilst standing at the patient's side. The edges of the fissure should now be pared; the mucous membrane of the middle part of each margin should be seized with hook-beaked forceps, and transixed with a narrow, sharp-pointed blade, which should then be run backwards and forwards, so as to remove a slip of the membrane throughout the whole line of the gap. I have found it most convenient, at this stage of the proceeding, to stand before the patient whilst paring the left side, and behind him while cutting on the right side; but if the surgeon can hold the different instruments in each hand with equal facility, he may stand as he chooses. During the time, and more especially after these incisions are made, small pieces of sponge rung out of iced water should be applied to clean the parts from blood and mucus; and the patient may also gargle the throat with cold water. The stitches should next be introduced thus:—a needle, set in a handle, armed with a portion of stout silk thread, three-quarters of a yard long, should be passed through the soft flap about a quarter of an inch from the free margin, half an inch or less from the posterior edge of the osseous palate, from below upwards, and when the eye appears above or in the gap, the thread should be seized and drawn into the mouth with a forceps; while the needle is withdrawn, the end of the ligature (as yet double) should be brought out from the mouth to facilitate future steps, and also to prevent slipping. The same needle, or another like it, armed with a thread of a similar length, but much thinner, should be passed in like manner through the other side of the left palate, exactly opposite the first puncture, and similar manœuvres should be repeated. By fixing this second thread to the bent end of the first, where it is hanging out of the mouth, and then withdrawing it in the course through which it has already passed, the thread intended to form the stitch will thus be brought through the opposite side of the palate, when one end of it (for it has as yet been double) can be drawn out, so as to leave both ready for knotting. Two, three, or four more threads, as may seem requisite, can be introduced in a similar manner; and now

all that remains to be done is to draw the edges together and fasten the thread. The foremost thread should be first tied in accordance with the ordinary mode of making the interrupted suture; and the others should then be treated in the same order in which they have been introduced. Should an additional suture seem requisite in any part of the fissure, it may now be introduced by pushing the same needle from one side to the other—for now, when the parts are more fixed by the sutures, this may readily be accomplished. Before fastening the two knots furthest back, the pared edges should be brought together to ascertain the influence of the palato-pharyngeus in dragging them asunder. If this action seems strong, or if there be difficulty in drawing the parts together, the threads should be pulled forwards, whereby the posterior pillars of the fauces will be put upon the stretch, when each should be cut about half an inch behind the uvula, in an outward direction to the extent of a quarter of an inch, and then there will be greater relaxation. Long curved scissors with blunt points are such as I use for this part of the operation, and the same are good for cutting off the ends of the ligatures, which is the last step in the operation.

“In some instances it may appear best to effect the division of the palato-pharyngeus before passing the stitches. If this be desired, the fibres can be put on the stretch by drawing the uvula forwards with the beaked forceps. It will rarely seem requisite to meddle with the palato-glossus, but if its division is thought advisable, the scissors just described will be the best instrument to use. A small horizontal wound in front of the tonsil, and about midway between the tongue and palate, will suffice.

“The hook-beaked forceps, and also that for seizing the thread, should be a little longer than those in common use; and the curved needle is similar to that often employed for the strangulation of hemorrhoids, nævi, and such like growths.

“I have named a stout silk ligature, as I think it preferable to any other kind. Sometimes I have used a hempen thread, but it is difficult to get the material sufficiently small and strong at the same time. I have never used the lead ligature, as recommended by Dieffenbach and others, and from my experience of the operation, should not feel inclined to try it. The threads to be used should be well rubbed with wax, and it is highly advantageous to have them of different colours, so that they may be more readily recognised during the proceedings.”

ABSCESS OF THE TONSIL, AND CHRONIC ENLARGEMENT OF THE TONSILS.

It is not unfrequently necessary to open an abscess in the tonsil. For this purpose some use a lancet enclosed in a sheath; but I have uniformly employed the apparatus used by Professor Fergusson and many others, namely, a straight bistoury enveloped in lint to within about half an inch of the point. The important precaution to be observed is, to keep the point of the instrument directed backwards and not outwards, lest the internal carotid artery should be endangered.

Chronic enlargement of the tonsil not unfrequently takes place to such an extent as to cause narrowing of the isthmus faucium, giving rise to difficulty of swallowing and breathing, and indistinct disagreeable arti-

culation. The disease consists of simple hypertrophy, and when it does not yield to proper treatment, the judicious proceeding is, to shave off the tonsil on a level with the folds of the velum.

The patient being placed opposite to a good light, and the tongue depressed, the surgeon seizes the tonsil with a vulsellum, and then applies the long narrow blunt-pointed knife to the under part of the tonsil, and, by a gentle sawing movement, shaves it off on a level with the folds of the velum. In removing the left tonsil, it will be convenient to hold the vulsellum in the left hand, and the knife in the right; and in removing the right tonsil, to hold the vulsellum in the right hand, and the knife in the left. I have never seen much hemorrhage after this operation, and have invariably found it most satisfactory in its results.

For removing a part or the whole of the uvula, a spring forceps or vulsellum for seizing, and a pair of curved scissors for cutting, answer as well as any instruments that could be desired.

Laryngotomy and *Tracheotomy* are terms applied (as their derivations indicate) to certain operations by which an artificial opening is made into the larynx and trachea respectively, for the purpose of admitting sufficient air to the lungs, when the natural entrance is closed or obstructed by disease, tumefaction, spasm, or impaction of foreign matter, so as to threaten death before the obstruction can be relieved by other measures, and for the purpose also of removing foreign bodies from the larynx, trachea, or bronchi. Both these operations are frequently referred to under the general name of *Bronchotomy*, which implies cutting the windpipe, without specifying any particular situation.

Foreign bodies of various forms occasionally enter the windpipe during inspiration, and more especially when this act is performed simultaneously with that of deglutition. These bodies are sometimes expelled by the convulsive coughing excited by their presence in the air-passages, after having remained, in some instances, for weeks, months, or even years; but in most of these cases, serious organic lesions of the lungs are induced by the long-continued irritation and inflammation, which accompany their presence and frequently continue after they have been thus expelled, so that life is, under these circumstances, usually very much abridged. In all such cases, therefore, it is proper to operate immediately after it is fully ascertained that a foreign body has lodged in the windpipe, and if possible before the supervention of

Fig. 281.

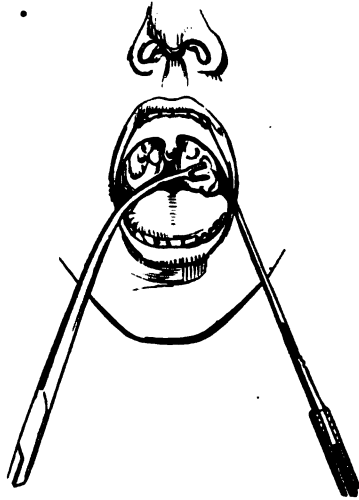


Fig. 281. From Liston.

inflammation. The presence of the body in the windpipe, will be known partly from the history of the case, partly from the signs and symptoms present or absent; and partly by ascertaining, by the fingers or some suitable instrument, that it is not in the pharynx. If it be found in the latter situation, it may frequently be withdrawn by the fingers; when in the upper part of the œsophagus, it can generally be removed by suitable forceps; or in some cases, when it is far down the gullet, and is of a digestible or at least not of an irritating character, it may in preference be pushed downwards to the stomach by the gentle use of the probang. But when the body, though situated merely in the pharynx, is so tightly fixed that it cannot be instantly withdrawn, while, by pressure on the epiglottis, or on the larynx from behind, it threatens instant death from apnoea, then bronchotomy must be performed, so as to maintain the respiration, and permit the foreign body to be extracted with sufficient deliberation and safety.

The operation is also specially advisable in oedema of the glottis, whether acute or sudden, and more chronic and slow in its attack; and either with or without chronic ulceration, or other disease of the larynx. It is also proper in idiopathic and traumatic inflammation of the larynx, when bleeding and other remedies fail to give relief, or at least fail to do so in time; for it must be remembered, that the operation of bronchotomy is not performed in these cases with the view of curing the disease, but only of counteracting one of its effects; its object is, to prevent the arrest of respiration by a mechanical cause, until the disease, which has given rise to the obstruction, shall have yielded to nature and suitable treatment. But undoubtedly the operation, if performed at a proper distance from the seat of the inflammation, assists in subduing its violence, as it temporarily relieves the glottis and upper part of the larynx from performing their usual functions in the act of respiration; and, by the local rest and relaxation thus afforded, the decline of vascular action is certainly favoured. The ultimate success of the operation depends very much on the period at which it is performed; and it should never in these cases be delayed a moment after it is plainly seen, that respiration is likely to be affected, or after the signs of deficient aeration of the blood are observed in the commencing duskiness of the countenance, and lividity of the lips. It is much more successful when the threatened apnoea is sudden in its attack, than when it slowly and gradually supervenes during disease of considerable duration.

In croup, a disease in which the trachea, and very frequently the bronchial tubes, even to their smaller ramifications, are affected, this operation affords little prospect of success: but it has succeeded in a few cases, apparently the most desperate, and may, therefore, be occasionally advisable, as a last resource. In diseases affecting the lungs alone, it is of course useless; but even in these, when the immediate cause of danger is referable to some laryngeal complication, life may be prolonged by the operation, a few hours, or perhaps even a few days.

Tumours connected with the larynx or trachea, either internally or externally, and even when at some little distance from the air-tube, sometimes interfere so materially with respiration, either by the me-

chanical obstructions they present, or by the frequent irritation and spasm of the glottis which they excite, as to render bronchotomy justifiable and necessary.

In cases of suspended animation, whether from immersion, strangulation, hanging, or from inspiring an impure atmosphere or noxious gas, bronchotomy frequently affords the only chance of recovery, by the quick and easy manner in which it permits the establishment of artificial respiration, and the insufflation of pure air. In instances of drowning, strangulation, and hanging, artificial inspiration may sometimes be maintained, without having recourse to operation, though not so satisfactorily or efficiently; but in cases of poisoning by inhalation of noxious vapours, the glottis is often spasmodically closed, and remains in this state for several hours after apparent or real death, so that bronchotomy is here almost always necessary to permit the establishment of artificial breathing. The cerebral congestion in cases of strangulation, hanging, and poisonous inhalation, is greater than in instances of drowning; and consequently there is a greater prospect of the operation proving successful in the latter case, than in any of the former.

Laryngotomy can be performed with much greater safety, speed, and facility, than tracheotomy; and in adults, it is generally the preferable operation in cases of suspended animation, or when there is reason to believe that the upper part of the larynx alone is affected with the obstructive disease, or when a foreign body has lodged there.

Tracheotomy is a more tedious and delicate operation, and is more exposed to accidental dangers from hemorrhage, and from unusual position of blood-vessels, than laryngotomy; but it is the most suitable for the removal of foreign bodies from the trachea or the bronchi, and when the whole larynx, perhaps, as well as part of the trachea, is involved in the disease which obstructs respiration.

Three situations have been recommended for the operation of laryngotomy; but in all ordinary cases, it is restricted to one of them, namely, the cricothyroid membrane. The operation is exceedingly simple, and may be performed in the following manner:

The head is bent back a little so as to stretch the integuments in front; the depression between the thyroid and cricoid cartilages is felt for; and a vertical incision of an inch or so in length is made in that situation, exactly in the mesial line. By this stroke, the skin, superficial fascia, and the fibrous tissue between the margins of the sternohyoid, sternothyroid, and cricothyroid muscles, may be divided. These are to be drawn a little to one side, which proceeding will be facilitated by bringing the head slightly forwards. The cricothyroid membrane may then be pierced by the point of the knife, which, after having entered and divided the membrane from above downwards, should be partially withdrawn, and its edge turned quarter round, and passed in again so as to cut transversely, making in this manner a crucial opening. Or the membrane may be pierced by a trocar. There is usually very little bleeding after this operation, although a small branch from the superior thyroid artery of each side runs across the membrane. If necessary, a laryngotomy tube of suitable size may be introduced.

Laryngotomy by cutting through the thyrohyoid membrane has been

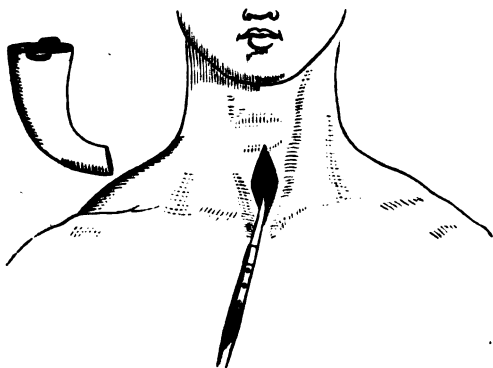
proposed by Malgaigne as affording a distinct view of the interior of the larynx. Such an operation may be useful for the purpose of removing bodies lodged in the upper part of the larynx, as in the ventricles, or caught in the rima glottidis; but the opening being made above the rima, which is the seat of greatest constriction; it is quite unsuitable for any other of the ordinary purposes of laryngotomy.

Velpeau has recommended laryngotomy to be performed by cutting through the thyroid cartilage; but this operation, which offers no counterbalancing advantages, is always attended with great danger of inducing or aggravating inflammation of the larynx, and of permanently impairing its functions as an organ of voice; in addition to which objections, it would often be very difficult to accomplish, especially in aged persons, on account of the frequent ossification of the thyroid cartilage in advanced life.

Tracheotomy is sometimes rendered a dangerous operation by the unusual distribution or course of arteries or veins, which occasionally are of no mean size. Before commencing the operation, however, the surgeon will be able to ascertain by his finger, whether any large artery is in the way, and so be prepared to avoid or secure it, as the case may require.

If the object of operation be to remove a foreign body, there should be at hand one or more long metallic probes, which can easily be bent to any form, with a plentiful supply of long and short forceps of various

Fig. 282.



forms and curves, having the limbs so adjusted that some may open laterally, and others in the antero-posterior direction, and constructed with points adapted for seizing the object to be extracted. In addition to these instruments, there should be a small sharp hook, and a curved "tube of a conical shape, and flattened laterally," as recommended by Mr. Liston. An adult patient is best placed in a sitting posture, in a good light, with the front of the neck made tense by the head being drawn back, supported on the breast of an assistant, and steadied by his

Fig. 282. From Liston.

hands. A small scalpel is employed in the cutting part of the operation, which consists, in the first place, in making an incision exactly in the mesial line through the skin and superficial fascia from the lower margin of the cricoid cartilage downwards, nearly to the top of the sternum. Any blood-vessel now seen must be drawn downwards, or aside, and each margin of the cutaneous wound retracted a little. Any loose cellular and fatty tissue present should now be carefully cut through, but still in the mesial line. The deep cervical fascia which covers and connects the apposed margins of the sternohyoid and sternothyroid muscles, must next be divided along the centre of their line of junction by the point of the scalpel; and the neck being now somewhat relaxed, these muscles are separated and drawn a little apart by the handle of the instrument, and by the finger, which is employed at the same time to discover, by pulsation, the presence of any unusual artery. Any vessels here found, whether arterial or venous, must be drawn out of the way, and the cellular tissue cleared off in the central line by the finger, or the handle, or the point of the scalpel. The isthmus, or central slip of the thyroid body, should be drawn upwards without being wounded, because, especially when unusually thick, it might furnish a troublesome quantity of blood. At this stage, if there be much hemorrhage, and the case be not one of urgent haste, it will be necessary to delay the opening of the trachea for a few moments, until the bleeding be arrested by means proportioned to its amount and character; but when possible, as it generally is when the mode here recommended is followed, it is better to finish the operation at once. For this purpose the patient is desired to swallow his saliva, during which action the larynx and trachea

Fig. 283.



are drawn upwards; but if the patient be insensible, or if he be a child, not understanding or not obeying the request, the upper part of the trachea is seized by the sharp hook already mentioned, and by it is drawn up and held steadily. In either case, at the instant when the windpipe is drawn up to its utmost, the point of the scalpel, having its back directed

Fig. 283. From Liston.

to the sternum, is introduced into the lowest portion of the trachea, thus exposing it to view, and is carried upwards so as to divide, in its course, three or four of the rings in the central line.

If there be oozing to any considerable extent, the trunk and neck of the patient should be inclined forwards, so as to favour the outward escape of the blood and prevent its flowing backwards into the trachea. At the moment when the air first rushes in, a curious and distressing sensation of anxiety and alarm is experienced, but this speedily subsides. If the operation was undertaken for the purpose of removing foreign matter, this should now be proceeded with. The patient's sensations usually refer its situation pretty correctly to a distinct spot; and the auscultatory signs may confirm or correct the impression as to its precise locality. The probe should now be employed, so as to discover more exactly the direction and distance of the object from the external opening; after which a forceps of suitable form is to be cautiously introduced, and the body extracted. Subsequently a tube, of the shape before described, which compresses the bleeding margins of the wound, and stops the oozing, should be introduced, until the oozing has completely ceased; after which it may be removed, and the wound allowed to heal of its own accord, no attempt being made to close it forcibly and hasten its union by dragging its edges together with sutures; at least, until the incision in the larynx itself has united, and the external parts of the wound appear disposed for adhesion, when a few plasters may be employed to preserve apposition.

When the operation is performed for the purpose of facilitating the restoration of suspended animation, or for maintaining the respiration during obstructive disease of the larynx, the tube may, of course, be introduced at once; but great care must, in this and in every case, be taken by frequently cleansing the canal of the tube to preserve it from being closed by accumulation of mucus or other secretion.

WOUNDS OF THE NECK.

[Condensed from Chelius's System of Surgery, by South.

"*Wounds of the Neck* either injure merely the coverings, the superficial muscles, or the deeper-lying vessels and nerves, the windpipe and gullet, or even the spinal-marrow. Cuts are the most frequent, and have either a vertical or transverse direction. If they penetrate merely through the skin and superficial muscles, they may be united with sticking plaster, and the union of transverse wounds on the front of the neck may be assisted by binding the neck forwards, but in longitudinal wounds it must be stretched backwards. Bleeding from the external jugular vein may be stanchied, either of itself or by slight pressure. In wounds with loss of substance, or such as suppurate largely, the head towards the end of the cure must always be kept straight, and the sinking of the pus behind the breast-bone prevented.

"Deeper penetrating wounds, in which the larger vessels are wounded, are usually soon mortal from the sudden bleeding. In injury of the carotid artery assistance is still possible if it be at once compressed by

an assistant at the wounded part, the wounded end laid bare and tied.¹ In slight injury of the internal jugular vein, the bleeding should be staunched by compression, or, if it be completely cut through, it must be compressed above the injury, and the upper end tied after proper enlargement of the wound. In making these ligatures sufficient care should be taken that the nerves lying close to the vessel, especially the pneumo-gastric, be not included in the ligature. The injured branches of the carotid artery may be tied either in the open wound, or after carefully enlarging it, or, if this be not possible, the principal trunk of the carotid is to be tied.

"*Injuries of the Pneumogastric Nerve* cause loss of voice, spasmodic symptoms, and death. Injury of the Recurrent Nerve also causes loss of voice; this, however, may occur subsequently. Injury of the Laryngeal Nerve is mortal from arrest of breathing;² and this is also the especial branch which so quickly produces death after the division of the whole nerve. According to Dupuy's³ experiments, animals may live for some time after division of both pneumogastric nerves, if the air-tube be opened below the larynx; but, if the opening be not made, the animal dies on account of the palsy of the nerves spreading over the muscles opening the chink of the glottis. If the Sympathetic or Phrenic Nerve, or the spinal marrow be injured, death in convulsions follows.

"*Wounds of the Windpipe* are either longitudinal or transverse; the windpipe may be either only cut into, or cut through, or a piece of it taken away as in shot-wounds. Vertical wounds of the windpipe require union with sticking-plaster, and that the head should be inclined much backwards. Transverse wounds divide it either partially or entirely; they are mostly consequent on attempted self-destruction, and are usually found at the upper part of the neck, between the larynx and the tongue-bone; penetrate to a great extent into the back of the mouth; allow the air, spittle, and drink to escape through them, or even penetrate into the larynx. They are rare at the lower part of the windpipe.

"In these wounds, if the voice be at once lost, the air passes through the wound, frequently an air-swelling is produced, and blood flowing into the windpipe may give rise to dangerous symptoms. This may occur without the carotid artery, jugular vein, or pneumogastric nerve being wounded; the bleeding may come only from the superior thyroid, or from the lingual artery.

"When in transverse wounds of the windpipe the bleeding is staunched, the edges of the wound should be brought together by bending the head

¹ Hebenstreit; in his additions to Benjamin Bell's Surgery Abernethy's Surgical Works, vol. ii. p. 115. Larrey, Mémoires de Chirurgie Militaire, vol. i. p. 115. Hennen, John, Observations, &c., p. 356. Collier; in the Medico-Chirurgical Transactions, vol. vii. p. 107. Cole; in London Med. Repository, May, 1820. Thomson, John, M.D., Report of Observations made in the British Military Hospitals in Belgium, &c., 1816. London. 8vo. Breschet; in French edition of Hodgson's Treatise on the Diseases of Arteries and Veins, &c., 1815. London, vol. ii. sect. v. p. 37, note. Textor; in Neuen Chiron., vol. ii. p. 2.

² Pye, Aufsätze und Beobachtungen aus der gerichtlichen Arzneiwissenschaft. Saml. vii. p. 185.

³ Journal de Médecine, par Le Roux, etc., vol. xxxvii. p. 351. Meckel, Handbuch der gerichtlichen Medecin. Halle, 1821, p. 172.

much forward towards the chest, in which position it is to be retained. This is done less certainly by bandages than by Kohler's cap; the patient is at the same time to be slightly inclined to one side, so that the secretion may not readily flow into the windpipe. If the windpipe be not completely divided, the edges of the wound should not be separated far apart, and the position already mentioned is favourable to union, as the stitches excite only irritation and cough, which mostly hinder the union. Only when the windpipe is cut through, and the edges of the wound gape widely, should they be drawn together with a broad ligature fastening the external skin merely.

"According to Fricke,¹ severe wounds of the neck should not at once be healed with the stitch; he prefers waiting for a perfect suppuration, and the production therewith of new granulations, and then first puts in the suture to bring the suppurating edges into contact.

("Position in the treatment of wounds of the windpipe, at whatever part, is always preferable to stitches, which are really of little service, as from the constant drag upon them in the frequent attempts made to get rid of the mucus, and of the adhesive matter which begins to be secreted a few hours after the injury, they speedily ulcerate and are of no use, but rather hurtful from their additional irritation. The only real benefit obtained from them is that of preventing the edges of the skin turning into the wound, which interferes with the union; but even in this attempt they often fail. Keeping the edges of the wound as near together as possible with strips of adhesive plaster, applied longitudinally and obliquely across the neck, and over these a roller twice or thrice around the neck, is all that is either necessary or proper.

"It must, however, be recollected that even at the very first it is not always proper to close the edges of the wound, and the surgeon must therefore carefully notice, in dressing the wound, how the patient can breathe when the edges are brought together and covered up. Not unfrequently the breathing cannot be carried on by the mouth, but only by the wound; under which circumstances, if the wound be shut up, difficulty of breathing and even suffocation may ensue, unless all the dressings be removed and the air allowed to escape by the wound. Its complete closure, therefore, must be dependent upon the freedom or difficulty of breathing by the mouth; if there be no difficulty the wound may be carefully closed; but, if there be difficulty, a sufficient space must be left opposite the wound into the windpipe, to permit the free passage of the air.

"Another circumstance may be also noticed as to the unneedfulness of stitches, that is, that these wounds rarely, if ever, unite by adhesion, but almost invariably by granulations, even under the most favourable circumstances. But the use of stitches after the establishment of the granulating process, as proposed by Fricke, is quite superfluous.

"It is certainly proper at first to attempt union by adhesion, and sometimes the angles of the external wound will effect it; but generally the parts have been so much handled in search of bleeding vessels,

¹ Fünfter Bericht über die Verwaltung des allgemeinen Krankenhauses, 1882, p. 282.

as well as irritated by their continual separation by the air and mucus forced through the wound, that the greater part of the surface becomes sloughy. When this happens, it is better to remove all the dressings, except two or three strips of plaster for support, and to surround the whole neck with a light bread poultice in a muslin bag, so as to prevent any of the crumbs dropping into the air-tube.—J. F. S.)

"In these wounds there always occur severe inflammation of the windpipe, spasmodic symptoms, especially severe cough, which is more violent in injuries of the larynx than of the windpipe. If the wounded person have not lost much blood, he must be bled freely from a vein, and nitre in emulsion must be given internally. If pain and cough arise, bleeding from a vein (even the application of leeches) must be repeated, and calomel with extract of hyoscyamus given. The food must be entirely fluid. Persons who have attempted self-destruction must be carefully watched, lest they disturb the bandages. This treatment must be persisted in so long as the inflammatory and convulsive state of the windpipe continues.

"If union do not completely occur, the wound is to be covered with lappets dipped in lukewarm water. If the discharge be great, and the powers of the patient give way, Iceland moss, bark, and narcotic remedies, must be used. The hoarseness which remains for the most part gradually subsides. In injuries of the cartilaginous part of the windpipe, there sometimes remains for a long while a fistulous opening, which often closes of itself. When the bandage is removed, the patient must guard against a deep inspiration, and much drawing the head backwards.

"*In stabs of the Windpipe*, owing to the parallelism of its inner and outer walls, the air readily escapes into the cellular tissue. If slight pressure upon the wound do not prevent the escape of the air, the outer wall must be enlarged with the bistoury, so that the air may more readily escape.

"*Bruised Wounds of the Larynx and Windpipe, Shot-wounds* with loss of substance, require besides the general treatment already mentioned, a simple linen bandage spread over with a mild ointment.

"If the edges of the wound skin over, and fistulous passage form, which especially occurs in bruises and in wounds connected with the loss of substance, the edges must be refreshed (repared with the knife), and, if possible, united vertically with the twisted suture. Attempts have been made to close the opening by healing over it a flap of skin.¹

"*Wounds of the Gullet* occur with an entirely, or, for the most part, divided windpipe (in stabs only is injury of the former possible without that of the latter), and the gullet is either cut into or cut through. Severe wounds of the gullet are usually accompanied with wounds of the larger vessels and nerves, and are then speedily mortal. Without this simultaneous injury, however, wounds of the gullet may be very large; it may even be entirely divided without the wound being absolutely

¹ La Lancette Française, 1831, 26 Nov. Froriep's Notizen, 1831, No. 692.

fatal.¹ Injuries of the gullet in large wounds can be ascertained by the eye, by examination with the finger, and also by the fluid swallowed by the wounded person, escaping through the wound, and exciting severe cough.

"When in wounds of the gullet the blood has been staunched, the same *treatment* is to be pursued as in wounds of the windpipe: the external coverings must be fixed, and the head bent towards the chest. If the wound be large, the patient must be supported with nourishing clysters, baths, or what is best, by strong broths introduced by an elastic tube into the stomach. The elastic tube kept in the gullet should be about as thick as the little finger, and provided with a valve at its top. It is introduced through the nose or mouth; it generally slips the first time into the windpipe, which must be ascertained by the motion of a taper flame held before the opening of the tube. In this case, the tube is to be drawn back, and an attempt made to pass it more backwards into the gullet. It may remain many days, its outer end being fastened. If the tube excite vomiting, coughing, or bleeding, it must be removed, and nourishing clysters and baths only used. Astley Cooper 'objects entirely to the introduction of tubes into the *pharynx* and *œsophagus*, as worse than unnecessary, for they are highly injurious by the cough which they occasion by their irritating the wound; and, if adhesion or granulation have taken place to close the wound, such tubes tear it open again and destroy the process of restoration.' The tormenting thirst of such patients is best relieved by putting into the mouth slices of lemon or Seville orange sprinkled with sugar. As the wound advances towards healing, pappy gelatinous food must be cautiously given by the mouth.

"As wounds of the gullet very rarely heal by perfect agglutination of their edges, but the interspace is filled by the neighbouring parts, there usually remains some contraction at this part, or it bulges like a bottle, in either of which cases swallowing is difficult.

"*Stabs of the Gullet*, if there be no accompanying severe injury, often heal without any symptoms. If the gullet be wounded at the lower part, the food that is swallowed may pass into the cavity of the chest.

"Deep wounds at the back of the neck often produce a palsied condition, and also frequently a wasting of the lower limbs. Wasting of the testicle and loss of the generative power have also been observed in these cases.

WOUNDS OF THE CHEST.

"*Wounds of the Chest* are either *superficial* or may penetrate into the *cavities of the chest*.

"*Superficial Cut and Sabre Wounds* require the same general *treatment*, and their union can always be produced by sticking plaster. *Superficial Stabs* (of which we satisfy ourselves by their direction, by the depth to which the injuring instrument has penetrated, and by examination with the probe, after placing the patient in the same position

¹ Rust, Einige Beobachtungen über die Wunden der Luft und Speise röhre, mit Bemerkungen in Bezug auf ihre Behandlung und ihr Lethalitätsverhältniss, in his Magazin, vol. vii. p. 262.

he was at the moment of the injury, and by the absence of the symptoms to be described in penetrating wounds of the chest) are also to be treated, according to the general rules, although the more active inflammation, which usually occurs in these wounds, requires a stricter antiphlogistic treatment. But when extravasation of blood takes place in the cellular tissue, and compression is not sufficient to staunch the bleeding, or when in the after-course of the wound a collection of pus takes place, and difficulty of breathing and so on occurs, the wound must be enlarged, the bleeding staunched, or a proper opening made for the escape of the pus.

“*Bruises and shot-wounds* of the coverings of the chest may produce large outpourings of blood in the external parts, inflammation of the pleura and lungs, difficult breathing, spitting of blood, and so on, and require a strict antiphlogistic treatment, repeated bleedings, and cold applications to the chest.

“*Penetrating Wounds of the Chest* either simply open the cavity of the pleura, or at the same time wound the viscera lying within the chest. Their danger depends generally on the bleeding which comes out of the walls of the chest, or from the viscera contained in its cavities, from compression of the lungs and heart by the collected fluids, from inflammation of the viscera of the chest, and their passages.

“We ascertain that a wound of the breast actually penetrates into the cavity of the chest, or even injures the viscera contained therein, by the depth and direction to which the injuring instrument penetrates; by the careful examination of the wound with the finger or with the probe, the patient being put into the same position as at the injury; by the influx and efflux of the air through the wound in inspiration and expiration; by an air-swelling (*emphysema*) which forms around the wound; by difficult respiration in consequence of the air which enters the cavity of the chest compressing the lungs and preventing the flow of the blood. In simultaneous injury of the lungs the patient suffers deeply-fixed pain; breathing, especially inspiration, is very difficult; a frothy, pale-red blood pours in an unbroken stream out of the wound; the patient spits blood (the absence of spitting blood is, however, no proof of the lungs being uninjured); sometimes also there are symptoms of internal bleeding and compression of the lungs, which are hereafter to be considered. The distinction of these wounds is more or less difficult according to their various size and direction.

“Examination with the probe is, in most cases, illusive and uncertain; it may be very injurious, from the irritation connected with it, and is in most cases useless, because the diagnosis is determined by other symptoms; and in a simple penetrating wound scarcely any other treatment is employed than in a wound that does not penetrate. The examination, by injection, as advised by many, is still more unsatisfactory, and always dangerous.

“The air passes freely in and out only when the wound is direct. The lungs do not always collapse, or fall together, when the cavity of the chest is opened, but remain in contact with the *pleura costalis*, which, in some cases, may depend on adhesion between the lungs and the *pleura*,

but in others, it is not to be explained. The opening, therefore, of both cavities of the chest is not directly mortal. Williams concludes from his experiments, 1st, that the lobe of the lung when exposed to the air does not collapse, so long as the functions of the other lobe and of the assistant organs continue undisturbed in respiration; 2d, that one lobe of the lung possesses a peculiar power of moving for some time, entirely independent of the diaphragm and intercostal muscles, when, indeed, the other lung respire; the origin of this power Williams cannot determine; 3d, that a sound lung recovers its natural expansive power when the pressure of the external air is removed; 4th, that although the external air passes freely and uninterruptedly at the same time through tubes of the same size into the cavities of the chest, the lungs, however, do not collapse, if the assistant respiratory organs have their activity still unrestrained; 5th, that a healthy lung never completely fills the cavity of the chest, at least in natural respiration. In my experiments on dogs, I always found great collapse of the lungs, and the motions which I noticed in them seemed to me less dependent on a distinct expansive power in the lungs themselves, than much rather on elevation and depression of the collapsed lungs in the laborious inspiration and expiration of animals, as will be described in accidents of the lungs.

"In endeavouring to determine the course which balls take when wounding the chest, Hennen's observation must not be forgotten, that 'a ball striking the body or a limb will run round under the skin, and appear to penetrate right across the member or the cavity. By the deep-seated course which balls sometimes take, the deception is rendered still greater. Thus I have traced a ball by dissection, passing into the cavity of the thorax, making the circuit of the lungs, penetrating nearly opposite the point of entrance, and giving the appearance of the man having been shot fairly across, while bloody sputa seemed to prove the fact, and in reality rendered the same measures, to a certain extent, as necessary as if the case had been literally as suspected. The bloody sputa, however, were only secondary, and neither so active nor alarming as those which pour at once from the lungs when wounded. There is also another source of deception as to the actual penetration of balls into the cavities or the limbs; this is where they strike against a handkerchief, linen cloth, &c., and are drawn out unperceived in their folds.'

"In regard to the *prognosis* of wounds of the chest, Hennen observes: — 'I should be unwilling to lull either a patient or a surgeon into a false security, or to underrate the real danger of any case; but I have seen so many wounds of the thorax, both from pike and sabre thrusts, and from gunshot, do well ultimately, that I cannot but hold out great hopes, where the *third day has been safely got over*, for though occasional hæmoptysis may come on, at almost any period during a case, and its approach can neither be entirely prevented nor anticipated, the more deadly hemorrhages are usually within the first forty-eight hours; and yet to this alarming symptom, when within moderate bounds, the safety of the sufferer is often due. Dr. Gregory of Edinburgh was in the habit of stating in his lectures, that of twenty-six wounds of the thorax received at the battle near Quebec, two only were fatal.'

"Penetrating wounds of the chest are most conveniently treated under the following conditions:—1. *Simple penetrating wounds*; 2.

Wounds complicated with the presence of foreign bodies ; 3. Penetrating wounds with bleeding ; 4. Penetrating wounds with protrusion of part of the lungs.

"*Simple penetrating Wounds of the Chest*, or those in which the cavity of the pleura merely is opened, are rare. Their treatment consists in the speedy closing of the wound, and in the prevention of inflammation. The patient, after a deep inspiration, should expire, and then the wound is to be carefully closed with sticking plaster, covered with a compress, and fastened with a broad chest-bandage and a shoulder-bandage. The patient is to be treated on a strictly antiphlogistic plan. If the inflammation be prevented, the wound heals quickly. If inflammation come on and be long-continued, consecutive extravasation from exudation of the pleura is frequently produced after a lapse of fourteen days, and renders the opening of the cavity of the chest necessary.

"*Foreign Bodies*, which complicate penetrating wounds of the chest, are either broken pieces of the injuring instrument, balls, pieces of clothes, driven into the wound, or splinters of the ribs. If the state of the injury do not itself point out the presence of foreign bodies, the symptoms by which it can be inferred are very equivocal. They excite constant irritation, difficult respiration, pain at the wounded part, even though the most severe antiphlogistic treatment has been long-continued ; or although the symptoms had diminished, a fresh accession, copious suppuration, and so on, may occur. The circumstances of the accident must be carefully reviewed, in order to determine on the presence and position of the foreign body, which is often most decidedly possible by the introduction of an elastic or metallic sound, for the purpose, either by suitable enlargement, or by a fresh opening in the interspace of the ribs corresponding to its position, when it can be done, to extract it. The longer suppuration is kept up by a foreign body in the cavity of the chest, so much more difficult is its extraction, because the interspace is much diminished by the falling together of the ribs. Larrey¹ has in one such case cut out the upper edge of the lower rib with the lenticular, as deeply as needful, for the purpose of extracting the ball, and did not wound the intercostal artery.

"Bullets may penetrate the chest, run round the lungs, and pass out nearly opposite their point of entrance (1). Instances have occurred in which bullets have lain in the cavity of the chest for a long while, without producing inconvenience ; in such cases they have been enclosed in a covering of coagulable lymph, as in a capsule (2).

"(1) See Hennen's Observations on this point *supra* p. 744.

"(2) In one case the ball remained in the substance of the lung for twenty years, the patient continuing in good health, and no symptoms occurring to indicate its position. In another, the ball rolled about in the cavity on every motion of the body.²

"In penetrating wounds of the chest bleeding may occur from the *arteria intercostalis*, the *arteria mammaria interna*, from the *lungs*, or from the *great vessels of the chest*. In large and direct wounds the blood flows out freely ; if the wound be narrow, if it form a long, and,

¹ Mémoires de Chirurgie Militaire, vol. iv., p. 250.

² Mangetus, Bibliotheca Chirurgica. Geneva, 1721, folio.

perhaps, curved canal, the blood empties itself into some one space internally, and the quantity poured out is relative to the size of the wounded vessel, and the space in which the effusion has taken place.

"Under such collection of blood in the cavity of the chest the face is pale, the pulse small and quick, the countenance shrinks, there is singing in the ears, cold sweats over the whole body, exceedingly difficult breathing, danger of suffocation; that side of the chest in which is the extravasation is more full and moves less during respiration; the patient breathes best on his back, with the upper part of his body raised; suffocation threatens if he lie on the sound side. As the extravasation increases, the symptoms become more severe, and the patient dies suffocated.

"The symptoms of extravasation of blood in the chest are very different and often very equivocal. If the extravasation be slight, or if it have been slow in its production; if the lung be adherent with the *pleura* to a great extent; if the individual be less sensible on account of the loss of blood; if previous disease of the chest exist; if spasmodic symptoms accompany the injury, then the diagnosis is extremely difficult.

"The *most certain and determinate signs* of extravasation of blood in the chest are, the continued symptoms of an internal bleeding, difficult, quick and short breathing, with spitting of blood in wounds of the lungs, in which inspiration becomes easier and expiration more difficult, and in sleep threatens suffocation; constant anxiety in a greater or less degree; difficulty or utter incapability of lying on the sound side; a dull sound on percussion of the chest, increasing with the increase of extravasation; the respiratory murmur accompanied with a gurgling murmur, and in a severe case of extravasation subsiding entirely, or perceptible only at the upper part of the chest; a tolerable condition when lying on the back with the chest much raised; irregular action of the heart and pulse; loss of sleep; pale, sparing, and even suppressed urine.

"The *less certain and constant symptoms* are, increased expansion of the wounded side of the chest, by which the ribs are separated from each other, and their mobility interfered with; oedematous swelling of the chest (in some parts at least the muscles appear more full); in the greater extent over which the pulsation of the heart can be felt, and its displacement to the opposite side by the pressure of the fluid; a sensation of weight on the chest, or an audible squash on the patient's motions; a swelling beneath the short ribs and in the region of the belly, from depression of the diaphragm; ecchymosis on the short ribs of the injured side, first occurring some days after the accident; oedema of the hand and foot, and redness of the cheek upon the injured side.

"The existence of extravasation may be distinguished with certainty when the symptoms described, or if not all, yet the most part of them appear together, continue, and increase; if they be unaccompanied with any other organic affection, and do not yield to general treatment in the first twenty-four hours.

"The blood extravasated into the cavity of the chest operates not only as a mechanical hindrance to respiration by compression of the lungs,

so that they gradually lose their cellular character, and unite with the *pleura*; whence it happens that, after long-continued extravasation, its discharge is of no use, the lung being no more capable of expanding itself; inflammation of the surface, with which it is in contact, also soon takes place, as the blood operates fatally by its decomposition, though it often continues long in its naturally fluid state. The bleeding must therefore be stanchied, the further extravasation be prevented, and the effusion into the chest removed.

“‘In incised or punctured wounds, hemorrhage takes place,’ observes Hennen, ‘instantaneously, and profusely; in gunshot wounds, if the intercostal artery or lungs are only brushed, or some of the more minute vessels opened, it is not so violent; and we have rather to prepare for what may occur on the separation of the eschars, than to combat any existing symptoms, the general tendency to pneumonic inflammation excepted. In the event of secondary bleeding from the lungs themselves, we are in possession of no external means for remedying it; but whenever the *tenaculum can* be used to an injured intercostal artery, it should at once be applied, and the vessel secured by ligature. Unfortunately, however, we but too often are disappointed in finding the source of the hemorrhage; and here judicious pressure is our only resource. In some slight injuries I have used the graduated compress with success; but if the sloughing is extensive, nothing but the finger of an assistant, relieved as often as occasion may require, and pressing direct upon a compress placed along the course of the vessel, or so disposed as to operate upon its bleeding orifice, will be of any avail.’

“It is very difficult in most cases, in many quite impossible, to determine the origin of the bleeding in penetrating wounds of the chest.

“*Injury of the Intercostal Artery* may be presumed when the wounded person does not spit blood, and when the symptoms of extravasation are urgent. If the wound be large, bright-red but not frothy, blood spurts from the wound in an unbroken stream; if the finger be put on the point where the artery is wounded, its spirting may be felt. The wound is directed towards the lower edge of the rib.

“We are rich in remedies proposed for staunching bleeding from the intercostal artery, but equally poor as to the effects which determine their fitness and applicability. To these belong the tying round of the rib according to Gerard,¹ Goulard,² and Leber;³ the tying the artery (without the rib) by means of an armed needle, jointed at its fore part, after the manner of Reybard and Nevermann; its immediate ligature proposed by Ben. Bell;⁴ the compression of Lottery,⁵ Quesnay,⁶ Bellog,⁷ and Harder;⁸ the compressors of Desault and Sabatier,⁹ by means

¹ Dionis, *Cours d'Opérations de Chirurgie*, par De la Faye, Paris, 1771, p. 841.

² *Mémoires de l'Académie des Sciences*, an. 1740.

³ Plenck, *Sammlung von Beobachtungen*, vol. ii. p. 210.

⁴ *System of Surgery*, 8d Edit. Edinburgh, 1787.

⁵ *Mémoires de l'Académie de Chirurgie*, vol. ii.

⁶ *Dissertatio de Hæmorrhagiæ Arteriæ intercostalis sistenda*. Berol., 1823.

⁷ *Médecine Opératoire*, vol. i., p. 179.

⁸ *Neue Bemerkungen und Erfahrungen* Berlin, 1781, vol. i., p. 59.

⁹ *Manuale de Chirurgia*. Milano, 1812.

of a square piece of linen, of which the middle is so deeply thrust into the wound and fitted with charpie, that if the ends be pulled the middle is pressed as a plug against the artery; or by a proper thick plug, furnished with a strong thread, passed through the wound, and, by means of the thread brought to the rib. According to Medin the wounded vessel should be completely cut through with a myrtle leaf, pushed back, and a tent pressed upon it. Assalini proposes cutting the artery through, and allowing it to retract; to close the wound carefully, and subsequently to discharge the existing extravasation.

"To employ the greater number of the plans of treatment recommended and above described, for staunching bleeding of the intercostal artery, a large wound is always needed, and if the wound be not large, it must be increased. They are generally to be considered as exceedingly dangerous proceedings, the result of which is always uncertain. If the uncertainty be remembered, in which the surgeon generally finds himself as to the source of the bleeding, and that in simultaneous injury of the lungs, the bleeding from those organs is increased by the employment of most of these remedies, the application of immediate ligature or of compression must not be unconditionally recommended. Injury of the intercostal artery, near the breast-bone or in the middle of the ribs, where most wounds of the chest occur, does not always produce severe bleeding, as foreign and home practice proves.¹ The injury of the intercostal artery, near its origin, always indeed causes very dangerous bleeding; but in this case also, on account of the depth of the artery, and also the knowledge of the source of the bleeding, is the application of the preceding means difficult and indeed impossible.²

"It is most suitable, therefore, in bleeding from the intercostal artery, to employ only such treatment as is pursued when the bleeding is from a vessel of the lungs, and to hope that by closing of the wound, by strict antiphlogistic treatment, by cold applications to the chest, by the pressure of the blood retained in the cavity of the chest, the wounded artery will become closed with a clot, after which the extravasation may be discharged in the usual way. Only in large, open wounds is the immediate ligature of the intercostal artery possible. If the *pleura* be not wounded at the same time with the intercostal artery, it may be attempted to staunch the bleeding by filling the wound with charpie.

"*Wounds of the Internal Mammary Artery* must be distinguished on anatomical principles and by examination, as in wounded intercostal artery. Between the fifth, sixth, and seventh ribs it must be nearly always accompanied with a division of the rib-cartilage; and it may be wounded without effusion of blood into the cavity of the *pleura*.

"What has been said in reference to staunching bleeding from the

¹ Ravaton, *Pratique Moderne de la Chirurgie*. Paris, 1785, vol. ii., p. 130. Spiess, above cited.

² Chelius, Ueber die Verletzung der Art intercostalis in gerichtlich medicinischer Hinsicht; in *Heidelberger klinisch Annalen*, vol. i., part iv., also vol. iii., part ii., and in Spiess, above cited. See also Von Graefe, Bericht über dasklinische chirurgisch-äugen-ärztliche Institut der Universität zu Berlin für das Jahr 1826. Berlin, 1827. And in *Journal für Chirurgie und Augenheilkunde*, vol. x., p. 869.

intercostal, in part, also, applies to that from the mammary artery. It may, perhaps, be taken up on the second, third, and fourth intercostal spaces. As to the other modes of treatment, only compression, by means of folds of linen filled with charpie, and the remedies advised for staunching bleeding from the lungs are to be employed.

"When the *large vessels in the cavity of the Chest* are wounded, the person dies quickly; only when the wound is small can he live for a little time. If no very large vessel be wounded, the symptoms vary.

"If the lungs be wounded at a part where they are connected with the *pleura*, there will not be any effusion into the cavity of the *pleura*, and that space only made by the wounding instrument into the lungs will be filled with blood; it flows out, if the external wound be sufficiently large, or filters into the cells of the lung itself. But if the lung be wounded at an unattached part, the blood will flow into the cavity of the *pleura*, and the symptoms already described will be produced.

"The staunching of bleeding from wounded lungs can only be effected indirectly.

"1. The power of the circulation must be so reduced by the most strict antiphlogistic treatment, by large repeated bleedings, that by the greatest quietude of the patient, by continued use of cold application to the chest, and cooling medicines, a plug may be formed in the opening of the vessel, which, under the weakened circulation, cannot be thrust out by the force of the moving blood, and consequently the wounded vessel is obliterated. The bleeding must therefore be so often repeated as the pulse begins to rise and to threaten, by the increased motion of the blood, the thrusting out of the just formed clot.

"2. The blood must be retained in the cavity of the chest, partly for the purpose of assisting the formation of the plug, partly to prevent its early throwing off. The wound must be, therefore, as already said, well closed with sticking plaster. If under this treatment the bleeding stop, of which we become aware by the cessation of the primary symptoms, by the return of the natural warmth, and so on, and the symptoms of extravasation still continue, then, after two or three days, we must proceed to open the cavity of the chest. Only when there is manifest danger of suffocation is this to be done earlier; in which case, however, a repetition of the bleeding is always so much earlier to be feared.

"*Emphysema* is that swelling which arises from the escape of air into the cellular tissue. It only rarely occurs in large and direct wounds; more commonly in those of which the external opening is not wide, and which have an oblique direction, as in stabs; and it is very common in broken ribs, when the bony points penetrate the lungs, and in shot-wounds, on account of the great swelling which closes the external opening.

"*Emphysema* takes place when the air penetrates through the external wound into the chest, and on account of the outer and inner wound not being parallel, is driven into the cellular tissue; or in wounds of the lungs when the air is driven through the cells of the lungs into the cavity of the *pleura*, and thence through the wound into the cellular tissue. In the former case the swelling is not large, and does not spread beyond the circumference of the wound; in the latter the swell-

ing is much more extensive and may spread over all parts of the body, the palms of the hand and the soles of the feet excepted, in consequence of which the patient has a frightful appearance. Emphysema is readily distinguished from all other swellings by the natural colour of the skin covering it, and by its peculiar crackling sensation when touched.

“When the air escapes from the lungs into the cavity of the pleura, and there collects, the same symptoms of compression of the lungs are produced as in extravasation of blood. Breathing is disturbed, and becomes extraordinarily difficult; the patient sits up, and bends forwards; the countenance becomes reddened and swollen, the pulse small and contracted; the extremities cold, and the oppression will quickly destroy the patient.

“If the emphysema be not very great, merely confined to the neighbourhood of the wound, it may be got rid of by the application of dispersing remedies. If it be greater, and raise the skin from the muscles, deep scarifications must be made in different parts, and the air discharged by squeezing. If suffocation threaten, the wound must be enlarged or a fresh but direct one made into the chest, by which the air passing from the lungs may freely escape. By enlarging the wound, or by opening the chest at another place, merely pressure on the lungs is prevented. Abernethy considers the application of a broad chest-bandage especially advantageous in emphysema, in order to prevent the motions of the chest.

“*Protrusion of a Portion of the Lung in Wounds of the Chest* is rare. It cannot arise, as has been falsely held,¹ from expansion of the lungs, but from the air in expiration streaming violently out of the wound, which as it is partially behind the lungs, forces, by its violent escape, the edge of one or other lobe of the lung into the wound. At least in animals I have never seen any other part protruded.² If the protrusion be recent, the lung healthy, and the condition of the wound permit, it must as quickly as possible be gently returned. In general it is necessary to enlarge the wound for this purpose. To prevent its reprotrusion, the wound must be properly closed and covered with a compress, which is to be fastened with a bandage. If the protrusion have existed long, if the protruded part be in a state of gangrene from the constriction, a ligature must be put on its base, and the protruded gangrenous part cut off in front, or left to itself.

“‘The sinking of the lung is not,’ according to Hennen, ‘a uniform consequence of a penetrating wound of the thorax. We have sometimes ocular proof of this, not only by the close contact in which the lungs lie to the wound, discoverable at first sight, but by protrusions which occasionally happen, and which, in the hands of the older surgeons, were removed by the knife,—a practice now rejected, and gentle pressure substituted.’

“*Inflammation of the Lungs and Pleura*, which are always to be feared in penetrating wounds of the chest, must be prevented or moderated by the strictest antiphlogistic treatment. The patient must be

¹ Richter, *Anfangsgründe*, vol. iv., p. 441.—Mayow, *De Respiratione*, Lugd. Batav., 1671, p. 5.—Halliday, *Observations on Emphysema*. London, 1807.

² Spiess, above cited.

kept in the greatest bodily and mental quiet: he must not speak; and take only cooling drinks and food. Nitre is to be given internally, attention paid to keeping the bowels open, and repetition of the bleeding as often and as largely as the condition of the patient may seem to require.

"Inflammation of the lungs and *pleura* may proceed to infiltration of the lungs with blood, to suppuration, or serous effusion into the cavity of the *pleura*. The suppuration of the lungs forms an abscess, which empties itself either by the mouth or into the cavity of the chest. In the latter case, and in serous collections in the cavities of the *pleura*, symptoms of extravasation appear, and opening the chest becomes necessary.

"*'Inflammation of the lung,'* says Astley Cooper, 'is to be guarded against by large and repeated bleedings, determined by the dyspnoea and hardness of the pulse; but there is little danger of bleeding too much in one of these cases, as it is an object not only to diminish the force of the circulation, but the quantity of blood in the pulmonary vessels. If *effusion* follows, it is the result of neglected inflammation, or of having closed the external wound too early. In the one case it is a purulent secretion; in the other a bloody serum, which produces the dyspnoea some days after the accident. For effusion into the chest, it is right to perform the operation for *paracentesis thoracis*, to draw off the pus or bloody serum which has collected. * * * In old persons there is great danger in fractured ribs with wounded lungs, and I always give a guarded opinion, for I have seen several die from effusion of fluid into the cellular tissue of the lung. The greatest care and quiet are therefore required in such a case, and it is better to give digitalis than to bleed very largely.'

"The symptoms of inflammation of the lungs and *pleura*, when they become severe, have great resemblance to those of extravasation. The circumstance distinguishing them is, that the symptoms of inflammation diminish after properly employing antiphlogistic treatment, whilst those of extravasation continue or increase.

"*Wounds of the Heart* are fatal, either suddenly by the bleeding, or the danger depends on the contraction of its fibres, if only some of them be divided, on the collection of blood in the pericardium, and on the difficulty of cure from want of rest, and the consequent addition and extension of inflammation. Only slight wounds of the pericardium and of the heart are curable when the inflammation has not been great; at least distinct scars from previous injuries have been observed on the pericardium and on the surface of the heart.¹ Cases, however, have occurred of wounds of the heart which have healed, in which several days after the injury, and independent of it, death has taken place, and the bullet been found in the heart.²

"We presume that the heart is wounded from the direction and depth of the wound. The peculiar symptoms given of this injury are, a more or less severe pain in the region of the heart, extraordinary restlessness,

¹ Richerand, *Nosographie Chirurgicale*, vol. iv. p. 8.

² *Dict. des Sciences Médicales*, vol. iv., p. 217. Penada, *Saggi scientifici e letterari di Padova*, 1794, vol. iii., part ii. p. 60.

and insupportable anguish; irregular intermitting pulse; cold extremities, cold sweat, and frequent faintings. The bleeding varies as the wound is superficial or deep; in both cases it may be absent on account of the peculiar contraction of the muscles, especially in oblique wounds. The blood either pours forth externally, or into the pericardium, or into the chest, with symptoms of extravasation and of internal bleeding. Special symptoms of wound of the pericardium and of the surface of the heart are not describable, and equally indistinguishable are the symptoms of the parts wounded. Perhaps the different colour of the blood in wounds of the left and right side of the heart might render a diagnosis probable. The right ventricle is most frequently wounded. Wounds of the arteries are as dangerous as those of the ventricles; in them a small wound may be closed by contraction of the muscular fibres.

“Only the most strict antiphlogistic treatment can in these wounds be employed. If extravasation into the pericardium take place, the making an aperture in it is the only though very doubtful remedy.

“Wounds of the pericardium sometimes occur without injury of the heart, and may be fatal.

“Wounds of the diaphragm, especially of its tendinous part, are always accompanied with the most severe pain, anxiety, cramps, and convulsions, against which a strictly antiphlogistic treatment must be employed. If the wound in the diaphragm be large, the intestines of the belly may pass through the opening into the cavity of the chest.”—
Ed.]

CHAPTER XXIV.

TUMOURS.

A CORRECT classification of tumours has always been acknowledged to be extremely difficult. In a histological point of view, they have been arranged into two grand divisions, namely, First, homologous, homœomorphous, non-malignant, or benign; Second, heterologous, heteromorphous, or malignant.

The first class comprehends those whose structure histologically agrees with that of some normal tissue. To this class belong, among others, fatty, fibrous, cartilaginous, and osseous tumours. Homologous tumours resemble normal textures in their histological composition, in their origin, in their mode of growth, and in forming persistent constituents; they do not depend on constitutional cachexy, are not apt to return, and have no tendency to convert surrounding textures into structures resembling their own; hence they are said to be non-malignant or benign. When tumours belonging to this class prove injurious, it is principally owing to their size, or to pressure on surrounding parts; and when they become the subjects of inflammation, it is owing to exposure to mechanical injury, or to irritation caused by pressure, or to some other external cause, and not to their own nature, or histological elements.

The second class comprehends those whose elements may be considered histologically to differ from those of the normal body, and which have a tendency to extend to surrounding parts, and change them into structures resembling their own; and from the very nature of their histological elements, have a tendency to proceed to softening. Carcinomatous and medullary tumours may be mentioned as examples of this class. They have also a tendency to return after extirpation, and are connected with constitutional cachexy.

In regard to the malignancy or non-malignancy of tumours, Vogel makes the following remarks:—"It has not always been clear wherein consisted the malignant, or non-malignant character of a tumour. It has been generally agreed, that the non-malignancy of a tumour consisted in the circumstance, that it would not be reproduced after extirpation; those which after extirpation were again produced, being held to be malignant. This view I regard as incorrect; tumours which are manifestly non-malignant, as, for instance, encysted tumours, may again reappear through the same originating force which first produced their development; whilst tumours notoriously malignant may never return after extirpation, or may even vanish of themselves, provided that the disposition to their formation no longer exists, as has been undoubtedly

shown in relation to the pulmonary tubercle. The malignity, which forms the grand division between these two classes of tumours, is connected with the very nature of the tumour itself, and depends on its histological elements."

Although objections have been urged against this division of tumours, inasmuch as some, tubercular tumour for example, may be as justly annexed to the one class as to the other, having some characters common to each, it has notwithstanding been considered by some of our best authorities to be more practically useful, and more conformable to nature, than any other classification as yet brought forward.

I. HOMOLOGOUS, HOMCEOMORPHOUS, NON-MALIGNANT, OR BENIGN TUMOURS.

I. SIMPLE SARCOMA.

Under this appellation have been comprehended simple enlargements, or hypertrophies, of organs; as, for example, simple or chronic enlargement of the mammary gland, testicle, or thyroid gland,—conditions in which the natural elements of the normal structure, though in an increased and altered condition, may be recognised by the aid of the microscope. But the term, simple sarcoma, has also been applied to tumours independent of special organs, which, it is believed, are formed by the change of exudation into cells and fibre cells. These ultimately assume the appearance of areolar tissue; vessels are developed, and the structure becomes incorporated with the tissue from which the exudation had taken place.

II. FIBROUS TUMOUR.

Seats.—Fibrous tumours occur in many different situations, but most frequently in the neck, in the neighbourhood of the parotid gland, in the uterus, in the neighbourhood of the mammary gland, in the skin, forming warts, in the nostril, constituting fibrous polypus, and connected with periosteum in other parts of the body. The uterus, nerves, subcutaneous cellular tissue, bones and periosteum about the jaws, are their most common seats.

Professor Paget, in his exceedingly interesting lectures on tumours, delivered at the Royal College of Surgeons of England, a few months ago, remarks regarding fibrous tumours:—"The usual distinction must be drawn between the tumours and the outgrowths of the same structure. The uterus presents examples of both. The fibrous uterine polypi, more properly so-called, are continuous outgrowths of, and from the substance of the uterus; the mucous membrane and the muscular and fibrous tissues of the uterus, growing in variety of proportions into its cavity and that of the vagina. The fibrous tumours, as distinguished from these, are discontinuous growths of similar tissue, in or near, but not of the substance of the uterus. The distinction is often difficult to make during life; for the pendulous, polypoid, and narrow-stemmed outgrowth may be imitated in all its external characters by a tumour growing near the surface of the uterus, and projecting into its cavity, with a gradually thinning investment of its muscular and mucous tissue."

Characters.—Fibrous tumour is slow in its growth; is unattended with pain or tenderness, unless accidentally inflamed; is extremely hard, globular in form, with its surface smooth or lobulated; is movable, and is enclosed in a cyst of condensed cellular tissue, by which it is separated from the surrounding parts. When situated in the neighbourhood of a gland, such as the parotid or mammary, it causes absorption; and from this circumstance comes apparently to occupy the situation of the gland; so that an incautious observer might be led to mistake the tumour for a disease of the gland. The tumour causes inconvenience, principally by its size and by pressing on surrounding parts, and, like all non-malignant tumours analogous to the normal elements of the body, by becoming the subject of inflammation, ulceration, and softening. These changes are produced by the influence of causes which are not inherent in its nature, but exoteric and accidental.

Fibrous tumours present considerable varieties in the histological arrangement of their fibres. In some cases the fibres resemble those of ligament, as in what is called the desmoid tumour; in some of a very firm elastic character, the fibres are compressed into a very solid mass, and are with great difficulty separated, as in what is termed the fibroid tumour; in some, the fibres are so compressed and firm, and the tumour is so uniform, having a homogeneous and white appearance, that this variety has been named *chondroid* tumour, from its resemblance in appearance to cartilage, although histologically its structure is quite different; in some, the fibres are arranged in concentric circles, presenting a most beautiful appearance when examined by the microscope; and in some, they run irregularly in every direction. By the characters mentioned above, and by the absence of the usual signs of carcinoma, it is generally easy to distinguish this form of tumour from cancer; but when it is not so, the diagnosis can only be established by the use of the exploring needle and the microscope; the presence of fibres and the absence of cancer cells will reveal the nature of the tumour. In some large fibrous tumours, especially in the uterus, calcareous salts are sometimes deposited, and these unorganized concretions have by some been incorrectly regarded as formations of bone. Another change met with in this class of tumours, is the formation of cysts. This has been thought to be due, in some instances, to the local softening or liquefaction of part of the tumour, or to an accumulation of fluid in the interspaces of the intersecting band; in others, to a process of cyst formation corresponding to that in cystic disease of the breast. These two changes have suggested to some the names of the “fibro-calcareous,” and the “fibrocysted” tumour.

Fig. 284.



Fig. 284. Section of a desmoid fibrous tumour of the uterus, after the addition of acetic acid.—From Bennett.

A multiplicity of fibrous tumours is not unusual in the nerves and the uterus, but in other situations they are single.

Treatment.—The proper treatment is removal at an early period, and in most of the situations, the only proper proceeding for accomplishing removal is excision. The preferable mode of effecting removal in the case of fibrous tumour of the nostrils, constituting fibrous polypus, has already been described in the section on Affections of the Nose.

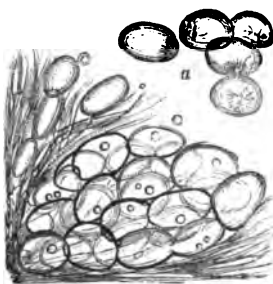
III. FATTY TUMOUR.

Professor Paget remarks, "There are both continuous and discontinuous morbid hypertrophies of fat; both fatty outgrowths, and fatty tumours, more properly so called. M. Lebert distinguishes the fatty tumours according to their degrees of isolation, as *Lipoma circumscriptum*, and *Lipoma diffusum*."

Seats.—Fatty tumour is found in all parts of the body, and at all periods of life, but most frequently under the common integument of the trunk, thighs, and shoulders; and although quite usual in both sexes, it is oftener met with in females than in males. A remarkable fact is, that they sometimes leave the spot where they began to grow, and take up another position.

Characters.—The principal characters of this tumour are, that it is painless, lobulated, elastic to the touch—which elasticity sometimes simulates fluctuation—exceedingly movable, and has the characteristic softness and pliancy of fat. The simple form, called simple lipoma, feels much lobulated; the encysted form feels globular and doughy, and is but loosely connected with surrounding parts. By these characters the diagnosis is generally made very easy. From deep-seated abscess, and from encephaloma, this form of tumour is distinguished, not only by the symptoms just described, but also by the absence of the characteristic signs of those affections.

Fig. 285.



Varieties.—There are several varieties of fatty tumour: 1. *Lipoma simplex*, the true fatty tumour, with little appearance of areolar tissue. 2. *Lipoma mixtum*, in which the fat cells are more or less separated from each other by penetrating portions of areolar tissue. In some cases, as in simple lipoma, the fat cells are diffused among, not distinctly separated from, surrounding parts; but in most, there is a fine cyst of cellular tissue to which the tumour is very loosely attached; but sometimes it is thick, and so much so as to give the appearance of an encysted tumour, although, the cyst and its contents being connected by organized structure, the essential condition of an encysted tumour is wanting. 3. Müller describes what he calls *Lipoma arborescens*, "ramifying productions consisting of fatty tissue, and occurring in the joints, especially in the knee-joint. Growths of this sort are covered by a prolongation of the synovial membrane, and hang loosely in the cavity of

Fig. 285. Structure of a fatty tumour removed from the back. *a*. Isolated cells, showing crystalline nucleus of margaric acid.—From Bennett.

the joint, forming arborescent tufts somewhat swollen at their extremities."

The state of parts in simple lipoma is described under the head of Lipoma of the Nose.

Treatment.—All attempts at discussion should be avoided, as being not only useless, but calculated to be injurious, by exciting irritation, inflammation, adhesions, incorporation with surrounding textures, and perhaps degeneration of the tumour. Removal by operation, than which few things can be more easy, is the only judicious proceeding. The cyst having been opened by incision, evulsion of the tumour is very readily effected by the finger alone, or by the finger and an occasional touch of the knife; dissection may be said to be scarcely required, unless incorporation with surrounding parts, adhesions or degeneration have been previously produced by stimulation or some other kind of injudicious treatment. The operation for lipoma of the nose has already been described.

IV. ENCYSTED TUMOURS.

Synonyms.—Encysted tumour, cystic tumour, and cystic sarcoma.

Seats.—Encysted tumours are met with in many different situations, but are most frequent in the mamma, in the testicle, and under the common integument of the head and face; they are comparatively rare in the limbs.

Characters.—It has been already stated, that fibrous and fatty tumours are found enclosed in cysts. In all such cases, the cysts constitute the means of connexion between the tumour and the surrounding parts, and an organized structure connects the cyst and its contents with each other; but the distinguishing peculiarity of those tumours to which alone the term encysted is applied, is that they have no organized means of connexion between the cyst and its contents. Encysted tumours are generally more or less of a globular form, unattended with pain or tenderness; the surface is usually unequal; the tumour feels solid at some parts; and there is more or less of fluctuation, depending on the number, size, and contents of the cysts.

Varieties.—Encysted tumours present great varieties, the principal of which are the following:—

First. Cystic tumours with simple cysts, the cysts being smooth or only marked by a few eminences. The cysts in different tumours differ much in thickness and in their contents, which are sometimes thin and watery, sometimes glairy, sometimes gelatinous, sometimes of a blackish appearance. In some instances where there has been irritation, they are of a purulent character; in others, they consist of various extractive matters and salts; sometimes they are of the consistency of honey, pap, or lard, and hence the terms meliceritious, atheromatous, or steatomatous. In some rare cases, the cysts have been found to contain hairs, teeth, horny structure, and true bony substance. This variety is named cystosarcoma simplex.

Second. The parent cysts in many instances contain smaller cysts in their interior, attached to the walls by pedicles. This variety has been called cystosarcoma proliferum.

Third. A third variety is called cystosarcoma phyllodes, "in which

the cysts, included in a sarcomatous substance, are ill-defined, form several cavities and chambers without a distinct proper membrane, and are filled more or less completely with solid, foliaceous cauliform growths from the floor and walls of the cavity. This form corresponds with the cystic formations, where solid granulations spring exuberantly from the walls of the cyst."

Treatment.—The proper treatment is to remove the tumour by excision; but the mode of proceeding varies in some respects according to the situation of the tumour and its firmness of connexion with the surrounding parts. If it be loosely adherent, as is usually the case when it is situated under the scalp, removal may be very quickly effected by making a longitudinal incision of the integument without opening the cyst; and the cyst and its contents may then be very quickly removed by pressing the integument on each side of the tumour, or by the use of a hook or forceps, or by pressing it out with the handle of the instrument. If the cyst and superimposed integument be at any part firmly adherent, it is better to commence the operation by making an elliptical incision comprehending the adherent part of integument. If the cyst be firmly incorporated with the surrounding parts, then, in some situations, dissection is preferable to any of the above-named methods of evulsion, and in others the sac should be opened and its interior touched with nitrate of silver. And if the whole of the cyst in any particular case cannot be removed, as is not very unusual when these tumours form in the eyelids, it should be touched with a small bit of caustic to insure its destruction.

V. CARTILAGINOUS TUMOUR.

To the valuable and elaborate investigations of J. Müller we are indebted for much information on cartilaginous tumours, which he designated by the term *enchondromata*. Chondroma, Enchondroma, Osteo-chondroma, and Benign Osteo-sarcoma are some of the names which have been applied to this tumour.

Seats.—Enchondromata may take place in the soft parts or in bone.

Fig. 286.



Examples of the former are comparatively rare. J. Müller met with only four in thirty-six cases of cartilaginous tumour; and of these four, one was in the mamma, one in the parotid gland, and two in the testicle; glandular structures being the only soft parts in which he found the disease. Its most frequent seat in the soft parts is in or near the parotid gland. Of enchondroma of bone there are two varieties; *central enchondroma in the interior of bones*, commencing in the centre of the bone, and enclosed in a thin bony case; and *peripheral enchondroma*, beginning on the surface, and furnished only with a fibrous covering from the periosteum.

This disease is very common on the metacarpal and metatarsal bones;

Fig. 286. From Druitt.

on the phalanges of the fingers and toes; on the femur and tibia near the knee joint; on the humerus, the bones of the pelvis, and the ribs; indeed there is scarcely a bone on which cartilaginous tumours have not been seen. The preceding delineation, copied from Druitt, gives a good idea of the appearance sometimes presented by this disease when situated in the hand.

For an exceedingly interesting and instructive account of the anatomy, physiology, and pathology of these tumours, the reader is referred to Professor Paget's valuable Lectures on Tumours, delivered in the Theatre of the Royal College of Surgeons of England, during 1851, and published in the "Medical Gazette."

Ossification is the only change connected with these tumours which has been considered as a development. When the process is complete, the bone consists of thin cancellous tissue enclosed in a thin compact shell or covering.

The different kinds of degeneration to which cartilaginous tumours are liable, are the soft and the fatty; of which the former is the principal: in it, part of the tumour becomes converted into soft or liquid matter, which has been found to present great varieties of appearance. Mr. Paget thinks, that, although in many instances this substance appears to be formed by a liquefaction of the tumour, it may in some be a blastema in which the process of development has failed, and that it may therefore be a degeneration, or a defect of development. Some cartilaginous tumours have been found to contain a pulpy substance of a yellow colour, and it has been considered probable that this is the result of fatty degeneration.

These tumours commence more frequently before the period of puberty than later in life; sometimes they are numerous, as may often be observed in the hands and feet; the tendency to them has occasionally

Fig. 287.



been found to be hereditary; and although a few cases are recorded in which they have been found to return after removal, such instances are

Fig. 287. Remarkable example of ossification of enchondromatous tumour. From a preparation in my collection.

very rare, and it may therefore be stated, as a general rule, that they are innocent tumours.

The preceding figure, taken from a preparation in my collection, is a good representation of a cartilaginous tumour on the metacarpal bone of the forefinger.

The finger was removed many years ago, and the patient has ever since been perfectly well.

The conjunction of cartilaginous and medullary tumours is by no means unfrequent in some organs.

When cartilaginous tumours are deep-seated, their diagnosis from cancerous tumours is not easy. Professor Bennett in his work on cancerous and cancrioid growths makes the following remarks on cartilaginous growths: "When enchondroma occurs in the extremities, and especially in the fingers and arms, is connected with the bones, and surrounded by an osseous capsule, its diagnosis from cancer is exceedingly easy. But when it is deep-seated, covered with soft parts, and has no distinct bony capsule, its detection is very difficult. It may thus be readily confounded with cancer of the bones, of which disease it presents all the general symptoms and signs; and if it be softened, it is not easily separated from cancer with the aid of the microscope, even after excision."

Treatment.—The only judicious method of treatment in a case of cartilaginous tumour is removal by excision, and that at an early period.

VI. AND VII. CALCAREOUS AND OSSEOUS TUMOURS.

The occurrence of calcareous and osseous tumours is not unfrequent. The former consist of unorganized deposits of calcareous salts, and, properly speaking, constitute concretions. These concretions are found between various histological elements, and among other situations are met with in the parenchyma of organs, as for example, in the testicle, in the mammary gland, and in the tonsils. They are also found in fibrous tumours, and in other structures of a fibrous character, and not unfrequently in the lymphatic glands, more especially in those of the neck and face, when they present the characters of a hard tumour, free from pain and tenderness, very movable, and for which the proper proceeding is excision.

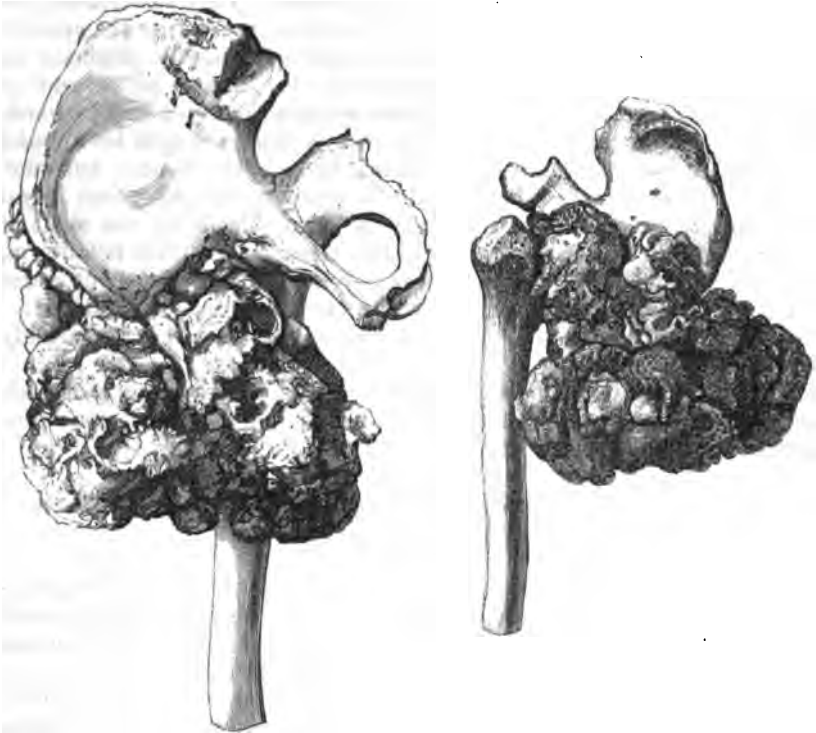
Osseous tumours are almost always met with in or upon bones. Examples, however, have occurred of osseous tumours formed of soft cancellous tissue and medulla, and completely isolated from bones. Among other examples of these extremely rare isolated osseous tumours, Mr. Paget refers to one in the Museum of the Royal College of Surgeons of England, and another in that of St. George's Hospital. The situation of the former was over the dorsal surfaces of the trapezial and scaphoid bones; the latter was imbedded in fibro-cellular tissue in front of the first metacarpal bone. Both tumours were perfectly isolated from the subjacent bones.

Osseous tumours have been divided into two kinds, the cancellous, and the compact or ivory-like: the former resembling the medullary tissue of healthy bone, and the latter, its compact walls. The difference in

the density of the two kinds is ascribed not to any difference in the component parts themselves, but in the degree of closeness with which they are compacted together.

Fig. 288.

Fig. 289.



Cancellous bony tumours are generally more or less round in form, though somewhat smooth upon the surface, more frequently present numerous lobes and nodules. They are slow in their growth, but often attain a great size. Mr. Paget mentions that the largest he has had an opportunity of seeing is in the Museum of the Royal College of Surgeons of England. It surrounds the upper two-thirds of the tibia; and measures a yard in circumference. The largest I have seen is one in my own collection, of which the two accompanying figures are good delineations:—

It is an immense mass of bone attached to the os innominatum, cancellous in its interior, nodulated on its surface, and covered by a thin layer of compact bone. The patient laboured under the disease for ten years, and died in consequence of the sloughing of the soft parts. As the osseous tumour was uncombined with other elements, it cannot be

Fig. 288. Remarkable osseous tumour of os innominatum. Front view. From a preparation in my collection.

Fig. 289. Back view of same preparation.

said to be an example of osteosarcoma, under which appellation many include all tumours in which bone is mingled with soft tissue. The viscera were perfectly healthy.

The compact or ivory-like bone tumours are very seldom found except in connexion with the bones of the cranium, or in the lower jaw; more rarely in the latter situation than in the former. They sometimes grow from the outer table and diploe of the cranium, presenting the appearance of outgrowths of those parts; but more frequently originate in the tables of the cranial bones, especially in the frontal sinus; and as their growth advances, they press inwards upon the brain, and forwards on the eye, as well as outwards. These tumours have also been found in other situations, as on the humerus, and on the femur; but such instances are extremely rare. In the Museum of the Aberdeen Royal Infirmary there is a specimen of a very large tumour on the shaft of the femur, which appears to belong to this class. Its surface is uniform, and its structure throughout exceedingly hard, the component parts being firmly compacted together, and everywhere free from friability.

Osseous tumours, when uncombined with other elements, are invariably non-malignant.

The bony part of medullary tumours of bone differs from the cancellous part of osseous tumours, not only in being infiltrated with cancerous matter, but also in being more friable.

II. HETEROLOGOUS, HETEROMORPHOUS, OR MALIGNANT TUMOURS.

SCROFULOUS OR TUBERCULAR TUMOUR.

This tumour owes its peculiarity to the presence of a particular deposit, called tubercular exudation, or tubercle. These exudations occur most frequently in young subjects from about the third year to the adult period; they are most common during childhood and youth in the lymphatic glands, especially the cervical and mesenteric; and in adults, they are met with much more frequently in the lungs than in other parts. They are found in almost all tissues, and are common on serous surfaces, in areolar tissue, and, as we have already seen, in the testicle. In the common scrofulous affection of the lymphatic glands of the neck, and in scrofulous disease of the testicle, we have two examples of tubercular exudation, which frequently come under the consideration of the surgeon.

Tubercular exudation is of a dirty white, or opaque yellowish colour, and of various degrees of consistency, from that of a tough cheese to that of a much softer substance. Vogel remarks, "Whenever tubercles are observed in what may be presumed to be their earliest stages, they appear solid, form a more or less dense mass, and fill up all the interstices of the elementary tissues in which they are deposited. The tissues are usually neither displaced nor altered by the tubercular matter; on the contrary, they in general retain their normal position; they are, however, as closely and perfectly invested by it, as the stones of a wall by solidified mortar which has been applied between them."

On microscopic examination, tubercular matter is found to consist of minute granules, and imperfectly developed cells, commonly called tu-

bercle-corpuscles. The proportion of the constituents varies in different cases. Some of these granules appear to consist chiefly of nitrogenized compounds, others of salts of lime, which occasionally, on the absorption of the animal matter, remain, constituting calcareous concretions. The tubercle-corpuscles are small, irregularly shaped, usually roundish, oval, or slightly angular, and contain several granules, but have no distinct nucleus.

As tubercular deposit contains no nucleated or reproductive cells, its increase can be effected only by fresh exudation. It may either remain without change, or be absorbed, or, by acting as foreign matter, may induce irritation and inflammation in surrounding tissues, and becoming

Fig. 290.

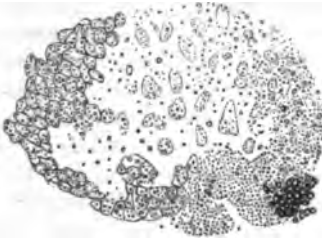
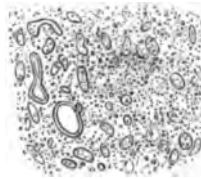


Fig. 291.



Fig. 292.



softened by admixture with inflammatory products, may with them form scrofulous abscess, in which the tubercular and purulent matters are commingled. Examples of such abscesses are of frequent occurrence. According to Engel, Vogel, and others, the causes of softening of tubercle may be referred partly to influences residing within the tubercular mass, and partly to external influences, as extreme moisture, suppuration in the surrounding tissues, &c.

Tubercle may result from perversion of nutrition, quite independently of the inflammatory process, or from an abnormal degree of vascular activity, whether merely congestion, or actual inflammation. When exudation of liquor sanguinis has been produced, the change into tubercle is believed to depend on the constitution or inherent composition of the exudation, which constitution is determined by that of the blood; and this being the case, the importance of attending to the nature of the food, of promoting the proper performance of the functions of the digestive organs, and of guarding against everything calculated to act unfavourably on the composition and properties of the blood, becomes evident. An excellent writer says, "In my opinion there is not a shadow of evidence to show, that the deposit of tubercular matter is always and necessarily preceded by inflammation. Yet an undoubted and most important *connexion* obtains between the occurrence of inflammation and the occurrence of tubercles. Tubercles will cause inflammation, and inflammation will determine the development of

Fig. 290. Tubercle-corpuscles, &c., from a soft tubercular mass in the lungs. From Bennett.

Fig. 291. Tubercle-corpuscles, &c., with and without acetic acid, from the lung.

Fig. 292. Tubercle-corpuscles, granules, and debris, from the brain.

tubercles. The enlarging tubercles excite inflammation in the surrounding textures by the pressure they exert upon them, and probably in other ways, by mechanically interfering with the circulation of the blood, for example; and the inflammation lit up is usually of the scrofulous kind; it is slow, and partial, and easily *quiesced* by treatment, though scarcely to be *cured*. On the other hand, there are numerous facts to prove that, in a person having the scrofulous diathesis, the occurrence of inflammation within the chest may arouse that previously dormant tendency into action, and become the exciting cause of the secretion or separation of the tubercular matter from the blood."

Tubercular exudation occurs exclusively in persons who have the scrofulous diathesis, which is therefore said to predispose to tubercle. This diathesis is hereditary, and is met with in persons of all temperaments, but is most usual in the sanguine and phlegmatic. The characters which indicate its existence in persons of the sanguine temperament are light hair, skin fine white, with a transparent brilliancy, allowing numerous subcutaneous veins to be seen shining through it; eyelashes long, silky, and graceful; iris grey or blue; eyeball prominent, the sclerotic having a shining whiteness or pearly lustre; the pupils large; the muscles flabby; the circulation feeble; the surface of the body easily chilled; and the digestive organs easily deranged. These are the principal physical characteristics, and with them are usually associated certain moral characters, namely, warm affections, quickness of perception, lively imagination, amiability of disposition, and a delicate and susceptible cast of mind. When the scrofulous diathesis exists in persons of a phlegmatic temperament, its principal characteristics are dark complexion; skin thick, pasty, and sallow; head large; eyes large and prominent; upper lip, in general, thick; expression of countenance dull and unpleasing; muscles soft and flabby; chest narrow; belly protuberant; circulation feeble; digestive organs liable to derangement, with other symptoms indicating feebleness of constitution.

The principal known exciting causes of tubercular deposit are, habitual insufficiency of food; deficiency of fresh air and exercise; residence in a low, damp situation; want of free exposure to the light of the sun; debility from excessive evacuations, or other causes; insufficient clothing; long-continued derangement of the digestive organs, and habitual mental depression. Dr. Alison says of the exciting causes of this deposit, "They may be ranked together as causes of debility, acting permanently or habitually for a length of time, although not so powerfully as to produce sudden or violent effects."

These considerations suggest very strongly, the necessity, in all cases where the scrofulous diathesis exists, or when the local manifestation has taken place, of generous diet; living in a dry bracing atmosphere; free exposure to the light of the sun and exercise in the open air; suitable clothing; maintaining a healthy condition of the skin by some of the different modes of bathing, or by sponging, and friction with a hair glove; the proper regulation of the digestive organs; and the cultivation of habitual cheerfulness. Some medicines, more particularly the preparations of iron, of quinine, or of quinine and iron, the syrup of the iodide of iron, cod-liver oil, and olive oil, are useful. It should be

kept in view, that as strength can only be acquired by the proper assimilation of nourishment, one of the most important indications to be fulfilled by medicine, is to put the digestive organs into a suitable state for the proper performance of their functions; and the medicine most likely to accomplish this desirable purpose should therefore be employed. Cod-liver oil is well known to be an invaluable remedy in all scrofulous affections, and in none is it more successful than in scrofulous disease of the glands of the neck, and scrofulous disease of the testicle. Of the beneficial effects of the internal use of olive oil in the same affections I am perfectly satisfied, from having used it extensively in these and many other scrofulous diseases. In many instances, cream is an efficient and agreeable substitute for the cod-liver or olive oil. It is well known that tubercular deposit is much more under the influence of constitutional than of local treatment. As to the latter, it seems unnecessary to add anything to what has been already stated regarding the local treatment of scrofulous disease of the testicle, except that, when the degeneration is in the testis, to an extent which is considered incurable, the proper proceeding is removal; whereas, when the disease is in the glands of the neck, and when the swelling goes on to suppuration instead of subsiding under the suitable constitutional and local treatment, it is advisable to promote suppuration, as being, next to discussion, the best means of cure. That the suppuration may be to such an extent as to insure complete disintegration of the tubercular deposit, which is very important, it is proper to delay the opening until suppuration be perfectly established, then to open the abscess by means of caustic potass, and, if necessary, to insure the complete destruction of the infiltrated part by the introduction of the caustic into it; after which, extrusion, granulation, and cicatrization should be promoted by the usual means. In many scrofulous affections of the glands in the neck, when there is scrofulous deposit, the above will be found the best mode of proceeding, when proper constitutional and local treatment has been fairly and fully tried, and has failed to produce discussion; but it must also be remembered, that slight suppurations occur in the glands of scrofulous persons as well as in those of others, when the best local treatment consists in making an early opening with a bistoury or lancet, as soon as fluctuation is discoverable, and before the tissues have become thinned or weakened. This proceeding will prevent the destruction of tissue, and the formation of a large cicatrix—unpleasant results of the first-mentioned mode of treatment; but it is chiefly applicable to those cases in which suppuration has taken place unconnected with tubercular deposit.

CANCEROUS GROWTHS.

As all writers have not affixed the same meaning to some terms used in the nomenclature of tumours of this class, it may be proper to mention that, in the following remarks, the appellations, Cancerous Growths, Cancer, and Carcinoma are used synonymously to denote a genus of disease of which there are several varieties or species, possessing certain principal characters in common, but having each at the same time some distinguishing peculiarities.

Of these varieties the four following are readily recognised: Carcinoma simplex, or Hard Cancer; Carcinoma medullare, or Soft Cancer; Carcinoma alveolare, or Colloid Cancer; and Carcinoma melanodes, or Black Cancer.

I. CARCINOMA SIMPLEX.

Synonyms.—Carcinoma, Carcinoma simplex, Carcinoma scirrhosum, Scirrhus, Scirrhomia, Scirrhusis, Stone and Hard Cancer, are some of the appellations given to this variety.

Common Characters.—Hardness is a distinguishing peculiarity of this variety; it is firm and incompressible; at an early stage it is freely movable, but subsequently becomes firmly attached to the skin and subjacent parts; its surface is nodulated; the veins superficial to it become, at an advanced period of its growth, tortuous and enlarged; at its commencement it may be attended with little or no pain, so that considerable progress may have been made before the discovery of its presence; but ultimately it is accompanied by acute pain of a lancinating character.

Fig. 293.



Fig. 294.



Fig. 296.

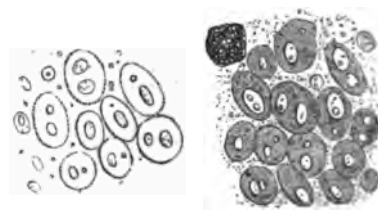


Fig. 295.

After removal it creaks, when cut with a sharp knife; a thin lamina is pellucid, but in the mass it is white, with a bluish tinge; it is seen to consist of *two* distinct substances, one of a comparatively soft consistency, of a satiny appearance, and a bluish-white colour; the other

Fig. 293. Portion of the section from a carcinomatous tumour of the breast; consisting of fibrous tissue and cysts, enclosing cancer-cells and granules. A compound granular corpuscle is also visible.

Fig. 294. Another portion of the same section treated with acetic acid. The fibrous tissue is rendered more transparent, and elongated nuclei are visible scattered through it. The nuclei of the cancer-cells are unchanged, while their walls are transparent. A compound granular corpuscle is seen at the upper part of the figure.

Fig. 295. Cancer-cells from the cream-like juice squeezed from the tumour. Numerous granules, and a compound granular cell are seen.

Fig. 296. The same after the addition of acetic acid.—From Bennett.

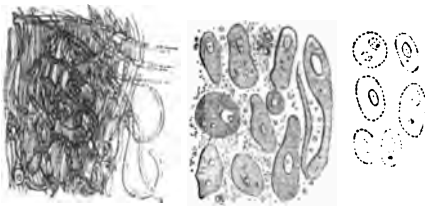
and larger, of an opaque white appearance, of a paler colour than the soft part, and consisting of numerous interlacing bands; it is heavy in proportion to its bulk, and unctuous to the touch: by pressure or scraping it yields a small quantity of cancerous juice, which, at an early stage, has the appearance of a clear transparent liquid, and afterwards of a white creamy fluid; it is not furnished with a capsule; does not present a distinctly defined border; and is irregularly blended with the surrounding parts.

Microscopic Characters.—When examined by the aid of the microscope, carcinoma simplex is found to consist of a fibrous matrix, so arranged as to form numerous cysts, in which, as well as between the meshes of the fibres, numerous cells are observed. These cells are highly developed, the walls being, in young cells, distended and smooth, and in old cells, flaccid and corrugated. In size they are variable, and in form they may be oval, caudate, round, spindle-shaped, oblong, heart-shaped, or of various indescribable forms depending on lateral pressure; and this diversity is their most distinguishing character in respect to form. Each cell contains one, two, or more nuclei with enclosed nucleoli; and frequently there is an appearance of cells within cells. The liquid contents of the cell-wall are at first transparent and colourless, but afterwards become opaque from the formation of granules and molecules. Water penetrates the wall by endosmosis, distending and raising it up. Acetic acid exercises its usual effect on it, dissolving it, and thereby making the nuclei more conspicuous. The fluid or juice

Fig. 297.

Fig. 298.

Fig. 299.



which can be scraped or pressed from a cut surface of the tumour is found to contain numerous cancer cells.

II. CARCINOMA MEDULLARE.

Synonyms.—Among the many names given to this variety are, Carcinoma medullare, Medullary Fungus, Fungus hæmatodes, Medullary Sarcoma, Medullary Cancer, Cephaloma, Encephaloma, Fungoid Disease, and Encephaloid, or Soft Cancer.

Common and Microscopic Characters.—This variety generally occurs at a much earlier period of life than the former; the tumour is less circumscribed, and its increase much more rapid; it is for a considerable

Fig. 297. Dense fibrous and elastic tissue, in which cancer-cells are infiltrated from cancer of rectum.

Fig. 298. Cancer-cells scraped from the surface, in the same case.

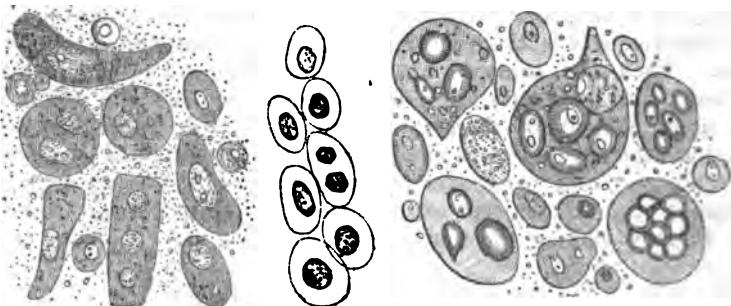
Fig. 299. The same after the addition of acetic acid.—From Bennett.

time attended with little or no pain, nor does manipulation produce any uneasy sensation; on palpation it presents a peculiar elastic feeling, which has sometimes by inexperienced observers been mistaken for fluctuation; the veins over it become congested; the skin retains for a considerable time its natural appearance, but changes in colour as the disease advances, presenting a dingy bluish tint; it becomes tense and painful, and by and by ulcerates; a bloody fluid is evacuated, which soon assumes a foetid character; a fungoid growth soon protrudes, presenting the appearance of an irregular surface of unhealthy granulations; the tumour comes to be attended with pain of a dull, heavy, sickening character; the fungus has a great tendency to bleed; the tumour increases very rapidly, affecting not only the surrounding parts, but also the neighbouring lymphatics and glands; and death soon takes

Fig. 800.

Fig. 801.

Fig. 802.



place in consequence of repeated bleeding, invasion of internal organs, cancerous cachexy, or, of gangrene of the upper extremity, as I saw very lately in a case of this disease in the breast, in which the gland and axilla presented one diseased mass.

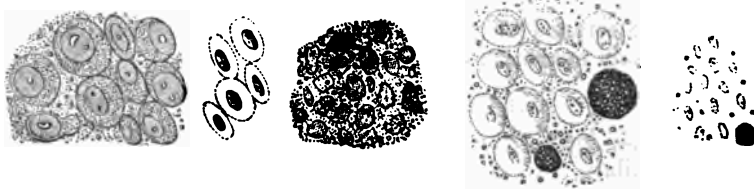
Fig. 803.

Fig. 804.

Fig. 805.

Fig. 806.

Fig. 807.



The tumour on being cut into is seen to consist in a great measure of a soft, white, opaque, pulpy substance, resembling in colour and consistency that of healthy brain, traversed with fibrous septa, which, however,

Figs. 800, 801. Older cancer-cells before and after the addition of acetic acid.

Fig. 802. Advanced cancer-cells, including secondary cells.

Figs. 803, 804, 805. Cancer-cells before and after the addition of acetic acid, also the structure of the reticulatum from encephaloma of the testicle.

Figs. 806, 807. Young cancer-cells before and after the addition of acetic acid.

are much fewer and thinner than in carcinoma simplex, resembling those of carcinoma simplex in the denser part of the tumour, but in the pulpy and broken-down portions, presenting only very slight traces. Extravasations of blood give to the cut portion, at some places, a reddish appearance, constituting what has been called by some, fungus hæmatodes.

The cells are more numerous than in the first variety, and more highly developed; and the cream-like fluid, when examined with the aid of the microscope, is seen to abound with cancer-cells in a high degree of development. In this form of carcinoma there is often observed a yellowish-coloured paste, sometimes reticulated, and sometimes collected into masses. This has been attributed to fatty degeneration of cancerous cells, and is described by Professor Müller as "cancer reticulare."

This variety of carcinoma differs from the former chiefly in density.

III. CARCINOMA ALVEOLARE.

Synonyms.—Carcinoma alveolare is sometimes called Colloid (from *κόλλα*, *glue*), and also Gelatiniform cancer.

It is comparatively rare, and is met with principally in the stomach and omentum; it is found to consist of fibres, so as to form loculi or areolæ, varying in size, and containing a soft viscous matter, sometimes

Fig. 808.

Fig. 809.

Fig. 810.

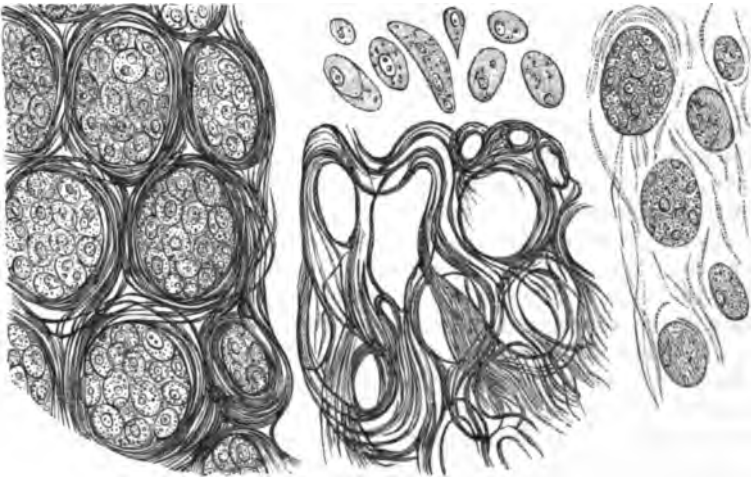


Fig. 811.

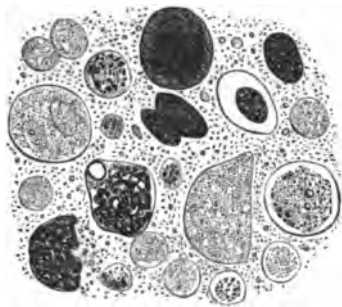
gray or amber-coloured, sometimes opalescent, or opaque, or of a greenish yellow colour. In this substance are found numerous nucleated cells, having the usual characters of cancer-cells. The accompanying figures, for which I am indebted to Professor Bennett, give a delineation of this form of cancer.

Figs. 808, 809, 810, 811. Structure of colloid cancer before and after the addition of acetic acid.

IV. CARCINOMA MELANODES, OR BLACK CANCER.

This tumour occurs much more frequently in the lower animals, especially in the horse, than in man ; but in man the malignant character is more marked. Its most common

Fig. 312.



primary seats are, the eye, the cellular tissue, and more especially the subcutaneous tissue, and that connected with the serous membranes. Sometimes it occurs as a distinct tumour with a fibrous stroma highly vascular, and with the colouring matter, which is non-vascular, diffused through it. When the colouring matter is viewed by the aid of the microscope, it is found to consist of minute granules, angular in form, and of a black, or brownish black colour.

It is frequently found associated with other morbid structures, especially with carcinoma medullare. It is attended with cachexia, has the power of invading surrounding structures, and assimilating them to itself, and shows the same progress as other malignant tumours ; and when the diathesis is established, the lungs, liver, bones, or other organs may be invaded.

ORIGIN, PROGRESS, AND TREATMENT OF CANCEROUS GROWTHS.

When exudation of liquor sanguinis has taken place, and has become coagulated, it presents, at the earliest period at which it has been examined, a finely molecular and granular appearance. This substance constitutes a blastema, in which the cancer-cells arise. The change of the exudation into cancer is believed to depend on the constitution or inherent composition of the exudation, which constitution is determined by that of the blood. Fibrous tissue, cancer-cells, and nuclei having been produced, the cancer-cells propagate themselves, the old cell-walls give way, liberating the young cells or nuclei, which in their turn give rise to others. Fresh materials for assimilation are afforded to the tumour by exudation from new vessels developed in it ; although just at the commencement of the disease, the exudation which constitutes the blastema, takes place from the old vessels. The tumour thus possesses the property of growth and reproduction, and in that respect cancer differs from tubercle, which can only increase by fresh exudation, and new development of tubercular matter in the exudation, as tubercle does not contain nucleated or reproductive cells.

There seems reason to believe that a cancerous tumour, after passing through its usual stage of growth, may degenerate or be transformed into fibrous cicatrix, by the absorption of its softer parts and the contraction of its fibrous stroma ; or into a fatty mass, by the deposition of

Fig. 312. Melanic cancer of the cheek. Cells more or less loaded with black pigment.—Bennett.

fat granules between the cell-walls and the nuclei, rendering the cancer cells abortive; or into a calcareous concretion by the absorption of the animal matter and the accumulation of the earthy salts of the exudation. But although these different forms of degeneration may have taken place in a very small number of instances, they are of so extremely rare occurrence, that no one thinks of looking for a spontaneous cure of cancer; on the contrary, it is found that the nature of the disease is to progress, and to conduct to death in some of the ways already mentioned.

The various forms of carcinoma appear to differ from each other principally in density, but to have all the same origin, the same progress, and the same result.

In regard to the treatment of cancer, one of the best authorities has said,—“The practical rule, which pathology and experience unite in causing us to adopt, seems to be this: *that so long as a cancer remains fixed in a part which is capable of being removed, and the strength of the patient is not too much reduced, so long is the surgeon warranted to interfere.*” Removal by excision is the advisable proceeding. If part of an organ be affected, the whole of the organ must be removed. In all cases, not only the whole of the tumour itself must be removed, but also a considerable portion of the surrounding tissue, lest cancer cells should have been infiltrated in the apparently healthy tissue: these, if allowed to remain, would insure a return of the disease. In every instance, therefore, the surrounding tissue should be removed to a considerable extent along with the tumour; for, although it must be allowed that in very many cases, even with this precaution, the disease returns: without it, its return may be said to be a certainty. It is equally important to resort to *early* excision, before the lymphatics have been invaded. Operative interference after the occurrence of lymphatic invasion could only bring discredit upon surgery, by subjecting the patient to a useless operation, followed by a return of the tumour; and, in all probability, in a form marked by increased rapidity of growth. The proper proceeding may, therefore, be said to consist in *early* and *free* excision. When the whole of the diseased part, together with some of the surrounding tissue, cannot be removed, or when the period of lymphatic invasion has arrived, the surgeon should then restrict his interference to endeavours to palliate the disease which he cannot cure, and to diminish the urgency of distressing symptoms as they occur in its progress.

Of late years, the chloride of zinc has been much used as an escharotic in the treatment of some cancerous affections; and there can be no doubt that, in some instances, it is an admirable application, and that its use accomplishes all that can be desired. It is made into a paste, by the addition of a very small quantity of water to render it liquid, and of as much flour as may be necessary to give it consistency. The length of time during which the paste should be applied, varies according to the depth of the part to be destroyed; but it may be stated generally to be from ten or twelve minutes to nearly half an hour. Poultices must afterwards be applied to promote the separation of the

slough, and the part afterwards treated as the common principles of surgery suggest.

The cases for which this method of treatment is suitable are, those in which the disease presents a considerable extent of surface compared with its depth;—cases in which, though removal is desirable, excision so generally preferable would, from some circumstance, be hazardous; and cases of comparatively superficial cancerous or cancrroid affections in patients who will not submit to operation. The use of this escharotic has been justly regarded as a valuable addition to the resources of the practical surgeon.

CHAPTER XXV.

AFFECTIONS OF THE BREAST.

MAMMITIS.

MAMMITIS, and mazoitis (from *μαζος*, *the breast*) are names given to inflammation of the breast, which may be either acute or chronic.

ACUTE INFLAMMATION OF THE BREAST.

This is a disease of very rare occurrence, except during the period of lactation, the active state of the gland then rendering it very susceptible of influences causing inflammation. These exciting causes may be general or local. To the former class belong irregularities of diet, cold, mental emotions, or any circumstance calculated to produce a decided impression on the system; and to the latter, contusions, external injury, the direct application of cold, and too long retention of milk.

The local symptoms are those usual in inflammation of a very aggravated form, together with diminished secretion of part of the gland, and suspended secretion, if the whole of the gland be inflamed. When the inflammation is very acute, resolution is rarely obtained, unless the treatment be early and energetic; and the result most apt to take place is suppuration, the matter forming an abscess called a milk abscess in the breast.

The constitutional disturbance is great, and usually commences with a rigour.

The object aimed at by treatment in the first instance, should be to obtain resolution. With this view all exciting causes should be removed; saline purgatives and antimonials prescribed, and the effect of the latter kept up; the diet restricted, and of an unstimulating nature. With regard to local treatment, support of the breast by means of a handkerchief, leeches, and fomentations, simple or anodyne, are the best remedies in the early stage; but if, instead of resolution, suppuration take place, early, free, and direct incision should be resorted to. By making an early, free, and direct opening, sinuses are prevented, much suffering is spared, and pressure for the purpose of evacuating the matter, which is not only painful but highly injurious, is rendered unnecessary. Warm fomentations and tepid water-dressings, or small poultices, are necessary for a short time; but all relaxing applications should be laid aside as early as possible, and gentle support afforded by means of strapping or gentle bandaging, and a change made to a more generous diet;—for in this, as in many other affections, recovery is sure to be delayed by the

long continuance of relaxing applications, or restriction to a diet not sufficiently strengthening.

CHRONIC INFLAMMATION OF THE BREAST.

The mamma is not unfrequently affected with a slight grade of the inflammatory process, which although attended with little pain often persists for a long time, and gives rise to enlargement and induration of the breast. This condition is usually symptomatic of some derangement of the menstrual or intestinal secretions, and is most common in females about the middle period of life, who are unmarried or have not had children. Swelling and slight induration are the principal symptoms, and they generally affect the whole, but in some instances only a part of the gland. There is little pain or tenderness. The swelling is less heavy than that of a genuine tumour, and usually more diffused. These symptoms, and the absence of the signs of the usual tumours of the breast, together with the readiness with which it yields to treatment, are the characteristic marks of this affection.

From what has been already mentioned it will be readily understood, that the proper proceeding in these cases consists mainly of constitutional treatment, the aim of which should be to promote a healthy condition of the menstrual and intestinal secretions, and to improve the general health and strength: from the fulfilment of these indications the greatest benefit is found to accrue. The local treatment consists principally in the use of some of the various discutient applications, and in the judicious employment of slight support and pressure by means of strapping or bandaging, chiefly of strapping. The effects of strapping must be carefully watched; but from its cautious use, together with suitable constitutional treatment, the most gratifying results are often obtained. Should the pain be at any time very acute, a few leeches and fomentations may also be employed.

CHRONIC ABSCESS IN THE BREAST.

The symptoms of this affection are a swelling, unattended with pain or tenderness, deep-seated, and generally about the size of an egg; the absence of any redness, heat, or swelling of the skin; and in the rest of the gland, the usual characters as to size and consistence.

This disease has been mistaken for tumour. The best means for arriving at a correct diagnosis are, the presence of the symptoms mentioned above; the equality of surface of the swelling; the feeling, more or less distinct, of fluctuation on careful examination; and the absence of the usual characters of the tumours of the breast. When the diagnosis is still doubtful, it can be made out by means of the exploring needle or a small puncture: the matter is contained in a firm cyst situated sometimes in the substance of the gland, but more frequently between it and the subjacent muscles. A dependent free opening is necessary; the wound must be kept open, and treatment adopted, according to the common principles of surgery, for promoting the filling up of the cavity.

IRRITABLE MAMMA, OR NEURALGIA OF THE BREAST.

This distressing affection is most frequently met with in persons from fifteen to thirty years of age. It does not seem to be confined to any temperament; I have often met with it in females of sanguine temperament, and often in pale cachectic females of nervous disposition, who have suffered from grief and mental anxiety.

In most cases pain is almost constantly felt, but with different degrees of intensity; so that the patient has remissions, rather than complete intermissions of pain. The pain is liable to great exacerbations, some of which are periodical, as for example, before the menstrual period, when it is often described by patients as being most excruciating. It is often excited also at other times by mental anxiety, and, judging from my own observation, I should say, by any cause, mental or bodily, by which a depressing effect is produced on the system. It is usually diminished during the menstrual period.

Tenderness on pressure is another symptom, and is in some cases so great that the slightest touch, and even the pressure of the dress causes great pain.

In many instances these symptoms are unattended with any enlargement; occasionally, however, there is slight enlargement, but very rarely any alteration of structure; yet sometimes there is the appearance of increased density, in some parts of the gland.

This neuralgic affection is, in the great majority of cases, regarded as symptomatic of painful or deficient menstruation; in some instances, of derangement of the digestive organs; and in others, of weakness occasioned by continued grief, mental anxiety, or other causes.

Some alleviation in this most distressing affection is sometimes experienced from the use of warm and opiate fomentations; from anodyne applications composed of preparations of conium, opium, belladonna, or aconite; or of combinations of these remedies, in the forms of liniment, ointment, or plaster. But, however necessary may be the employment of some local remedies as palliatives, the principal part of the treatment, and that on which alone dependence can be placed for effecting a cure, is the constitutional treatment, comprehending the use of such remedies as are calculated to promote the proper condition of the uterine and intestinal secretions, and to improve the general health and strength. A complete change of scene, air, and mental occupation has often been found to remove the complaint. The practitioner, remembering what are the indications to be fulfilled, will select for their accomplishment the means most suitable in the particular circumstances of each case.

MAMMARY GLANDULAR TUMOUR.

Synonyms.—This affection is called by Sir A. Cooper the chronic mammary tumour; by Mr. Abernethy the pancreatic tumour; by Cruveilhier the fibrous tumour of the breast, by Professor Paget the mammary glandular tumour; by some writers simple sarcoma; and by others simple tumour.

These tumours are most common in young women who are unmarried,

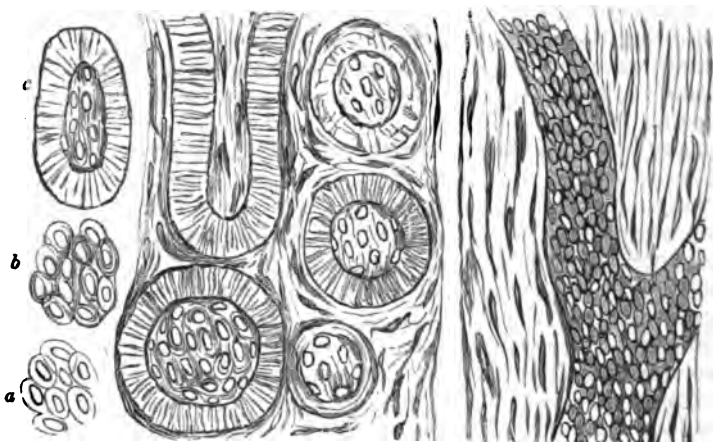
or who have had no children : they are very seldom found to begin after the age of thirty years. Their origin is believed to be connected with deficiency or irregularity of the menstrual discharge ; and a remarkable fact in regard to them is, that they occasionally disappear ; and, according to a greatly respected authority, they are more likely to do so, if any imperfection of the uterine or ovarian functions, in which they seem to have their origin, be repaired by marriage, pregnancy, or lactation.

The tumour is exceedingly movable, and though furnished with a cyst, is diffused into the surrounding tissue to a considerable extent. Its form is usually oval, its surface lobulated, it has no elastic or firm feeling ; its seat may be upon, within, or in some rare instances, under-

Fig. 813.

Fig. 814.

Fig. 815.



neath the gland ; it is most usually found near the upper margin of the gland, slightly imbedded beneath its surface. In most instances there is no accompanying pain ; in some, there is uneasiness not amounting to pain ; and in others, very great pain. These tumours are sometimes very rapid, but more frequently slow in their growth ; sometimes their growth appears to be arrested so that they become stationary ; and in a few instances, as has been already mentioned, they have been known entirely to disappear. They are formed of hypertrophy or alteration of the natural elements, and by the aid of the microscope, these elements in a more or less modified form may be recognised. By the kindness of Professor Bennett I am allowed the use of the above wood-cuts.

These tumours are innocent in their nature, and very rarely attain to

Figs. 813, 814, 815. This series of diagrams represents microscopic sections of a simple tumour removed by operation from the female breast ; consisting mainly of hypertrophy of the fibrous structure of the gland, with enlargement of the included ducts and their epithelial linings. *c.* Section of the epithelium from one of the tubes. *b.* Group of epithelial cells from the same. *a.* The same after the addition of acetic acid.—Bennett.

any great size; but as they may grow larger and give rise to anxiety in the mind of the patient, they should be removed by excision, which can be done with great ease and with the certainty of a satisfactory result, as they are not of a malignant character.

SERO-CYSTIC TUMOUR.

The following are three different modes of the formation of cysts:—

1. Some cysts are formed by dilatation and growth of the lactiferous tubes. A cyst formed in this way may be emptied through the nipple, and as was pointed out by Sir Benjamin Brodie, a bristle may in some cases be sent through one of the ducts into the cyst. The cyst is slow in its growth, rarely attains very large dimensions, and in the majority of cases is unattended with pain; but in some, patients experience a darting pain, or stinging, especially on manipulation, and about the menstrual period. In most cases, however, the disease gives rise to no inconvenience, except the anxiety caused by the presence of any kind of tumour in the breast. The health is not impaired. The skin retains its natural colour. The axillary glands do not become affected: and on manipulation at an advanced period, fluctuation reveals the existence of a fluid, but at an early stage, the tumour has rather a solid feeling. The cyst has a covering of fibro-cellular tissue, is lined with epithelium, and may contain milk, or a fluid containing epithelial scales, or fatty matter, but most commonly serous fluid, which sometimes exudes from the nipple. The fluid may be clear, green, reddish, or variously tinged. It is extremely unusual for this disease to begin after the fiftieth year.

2. Another mode of formation of cysts is by enlargement and fusion of spaces of the fibro-cellular tissue. Effusion takes place into the spaces, and the fibro-cellular tissue becomes expanded and condensed into a cyst.

3. It is probable that, in many instances, cysts in the mammary gland are formed by the enormous growth of new-formed elementary structures, having the character of cells or nuclei, which pursue a morbid course from their origin, or from a very early period of their development.

These three modes of the formation of cysts have been briefly described, as formation by dilatation and growth of parts of ducts, by enlargement of natural spaces, and by development or growth of new-formed nuclei or cells. Those cysts, the contents of which are liquid, are called barren; and those which have the power of forming more highly organized contents are called proliferous. The contents of proliferous cysts vary very much in different parts of the body, but in the breast they consist of glandular or other vascular growths, which spring from their walls, constituting with their cysts the cysto-sarcomata of Sir Benjamin Brodie. These intra-cystic mammary growths increase more rapidly than their cysts, and at length, excluding the fluid, fill the cysts; in many cases, they coalesce entirely with the cyst walls, and in others, projecting through them and growing rapidly, they advance to the integument; and sometimes even make their way through it. These growths also exhibit great varieties with regard to colour, vascularity, and density. They

are found in women of all ages from the period of puberty to the cessation of menstruation: and although they may coexist with cancerous

Fig. 816.



growths, they are perfectly free from anything of a malignant character.

In the case of a single cyst, a successful result has been obtained by making an incision for the escape of the fluid, or evacuating it by means of a small trocar, and afterwards employing the ordinary means for promoting the obliteration of the cyst by adhesion or granulation; but excision of the whole of the diseased part is the only certain means of cure; and when there are more cysts than one, the proper proceeding is ablation of the breast, and as the disease is not malignant, there is every prospect of a satisfactory result, if the whole be removed.

TRUE HYDATID CYSTS IN THE MAMMA.

This is an extremely rare form of breast-disease, and consists of a parent cyst, containing living entozoa. Within the parent cyst are secondary cysts, which consist of parasitic animalcules, named *echinococcus hominis*, floating in a limpid fluid. This form of disease is met with between the ages of twenty-one and fifty years, chiefly in married women who have enjoyed good health, to which the development of the tumour has not been observed to cause any interruption. The tumour is for the most part globular or oval in form; varies in size from an inch to several inches in diameter; and has been found in different parts of the gland. The tumour becomes prominent at its middle, is hard at first and incompressible, but by and by becomes lobulated with obscure fluctuation, and ultimately fluctuation becomes uncommonly distinct. In some cases there is no pain; in some there is uneasiness; but in others the pain is very great.

Excision is the proper treatment, and if the cyst be removed, a perfect cure is the result.

Besides the tumours mentioned in this chapter, the mamma is also liable to become the seat of fatty, fibrous, fibro-serous, cartilaginous, or

Fig. 816. From Druitt.

carcinomatous tumours. For information on these tumours the reader is referred to the preceding chapter, in which their characters, progress, and treatment, have been described.

EXCISION OF THE MAMMA.

The patient having been placed in the recumbent posture, with the arm raised, extended, and committed to an assistant to maintain it in that position, the surgeon introduces the knife on the axillary aspect of the mamma, on a line with the mammilla, and directs it quickly and boldly to the opposite point, forming a semielliptical incision along the lower aspect of the tumour; the lower incision being first made that its course may not be obscured by blood. A semielliptical incision is then made along the upper aspect between the same points of entrance and exit. The knife being next carried in a sloping direction, the dissection is conducted boldly and promptly from the axillary aspect of the wound, in order that by the early division of the principal trunks hemorrhage may in the subsequent parts of the dissection be as much as possible prevented. The extent of parts to be removed must vary to a certain degree, according to the laxity of the integument, but chiefly according to the size and nature of the tumour, it being necessary, as has been already stated, to remove a considerable portion of apparently sound tissue, if there be reason to fear that the tumour is not of an innocent character.

Hemorrhage having been arrested, the edges are brought together, and the parts treated according to the approved principles for such wounds.

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